
TO 31R2-2TRC199-1

OPERATION AND MAINTENANCE INSTRUCTIONS WITH ILLUSTRATED PARTS BREAKDOWN

ORGANIZATIONAL LEVEL

RADIO SET AN/TRC-199 (TACTICAL REPEATER)

RACAL COMMUNICATIONS, INC.
5 RESEARCH PLACE
ROCKVILLE, MD 20850

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TABLE OF CONTENTS

<u>Chapter</u>	<u>Page</u>
LIST OF ILLUSTRATIONS	iv
LIST OF TABLES	iv
SAFETY SUMMARY	v
FOREWORD	ix
 CHAPTER 1.0 GENERAL INFORMATION.....	 1-3
1-1 DESCRIPTION AND PURPOSE.....	1-3
1-1.1 Equipment Function and Purpose.....	1-3
1-1.2 Equipment Description.....	1-3
1-2 LEADING PARTICULARS.....	1-5
1-3 CAPABILITIES AND LIMITATIONS.....	1-6
1-4 EQUIPMENT SUPPLIED.....	1-7
1-4.1 EQUIPMENT REQUIRED BUT NOT SUPPLIED.....	1-8
1-5 SPECIAL TOOLS AND TEST EQUIPMENT.....	1-8
1-6 RELATED TECHNICAL MANUALS.....	1-8
 CHAPTER 2.0 INSTALLATION	 2-1
2-1 INTRODUCTION.....	2-1
Section I. INSTALLATION LOGISTICS	2-1
2-2 SITE PREPARATION.....	2-1
2-3 UNPACKING AND INSPECTIONS.....	2-1
2-4 HOUSING.....	2-3
2-5 RECEIVING DATA.....	2-3
2-6 MATERIAL HANDLING.....	2-3
2-7 CABLES.....	2-4
2-8 BUILDING AND OTHER SUPPORTING STRUCTURES.....	2-4
Section II. INSTALLATION PROCEDURES.....	2-5
2-9 SPECIAL TOOLS AND EQUIPMENT REQUIRED FOR FIELD INSTALLATION.....	2-5
2-10 INSTALLATION SEQUENCE.....	2-5
2-10.1 Antenna/Mast Installation.....	2-5
2-10.2 Lithium Battery Installation.....	2-9
2-10.3 Ground Rod Installation.....	2-9
2-10.4 External Power Supply.....	2-9
2-10.5 Diplexer Installation.....	2-9
2-10.6 Receiver-Transmitter Transceiver Module Installation.....	2-9
 CHAPTER 3.0 PREPARATION FOR USE AND RESHIPMENT	 3-10
3-1 INTRODUCTION.....	3-10
Section I. PREPARATION FOR USE	3-10
3-2 INSPECTION.....	3-10
3-3 POST-INSTALLATION CHECKOUT.....	3-10
3-3.1 Preliminary.....	3-10
3-3.2 Alignment and Adjustment.....	3-2
3-3.3 Post-Installation Checkout Procedures.....	3-2
Section II. PREPARATION FOR RESHIPMENT	3-2
3-4 PREPARING UNIT FOR RESHIPMENT.....	3-2
3-5 PACKING.....	3-2
3-6 HANDLING AND STORAGE.....	3-2
3-6.1 Protective Measures for Electrical Connectors.....	3-3
3-6.2 Preparation for Shipment and Storage.....	3-3
3-6.3 Handling.....	3-3

CHAPTER 4.0 OPERATION	4-1
4-1 INTRODUCTION	4-1
4-2 CONTROLS AND INDICATORS	4-1
4-2.1 Indicators, Controls and Switches	4-1
4-2.2 Power Supply Switches and Connectors	4-1
4-2.3 Connectors	4-1
4-2.4 Diplexer Controls	4-1
Section II. OPERATING INSTRUCTIONS	4-7
4-3 INITIAL POWER-UP AND DIPLEXER TUNING PROCEDURES	4-7
4-4 RECEIVING AND RETRANSMITTING MESSAGE	4-8
4-5 COVERT OPERATIONS	4-8
4-6 RECEIVER-TRANSMITTERS	4-8
4-7 EQUIPMENT SHUTDOWN	4-8
Section III. EMERGENCY OPERATION	4-8
4-8 EMERGENCY POWER	4-8
4-9 ELECTROMAGNETIC PULSE PROTECTION	4-9
4-9.1 EMP Susceptibility	4-9
4-9.2 EMP Protective Measures	4-9
4-10 NUCLEAR, BIOLOGICAL, AND CHEMICAL(NBC) CONTAMINATION	4-9
 CHAPTER 5.0 THEORY OF OPERATION	 5-1
Section I. FUNCTIONAL SYSTEM(S) OPERATION	5-1
5-1 GENERAL	5-1
5-2 FUNCTIONAL SYSTEM(S) OPERATION	5-1
5-2.1 +15V DC-DC Converter Circuit Card Assembly (CCA) (A1)	5-1
5-2.2 Repeater Control Circuit Card Assembly (CCA) (A3)	5-1
5-2.3 Parent Board Circuit Card Assembly (CCA) (A4)	5-1
5-2.4 Control Panel (A5)	5-1
5-2.5 RF Power Amplifier Assembly (A6)	5-1
5-2.6 +28V DC-DC Converter Circuit Card Assembly (CCA) (A7)	5-3
5-2.7 Receiver-Transmitter	5-3
5-2.8 Antenna System	5-3
5-2.9 Diplexer	5-3
5-2.10 AC/DC Power Supply (A2)	5-3
Section II. FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS	5-4
5-3 REPEATER CONTROL CIRCUIT CARD ASSEMBLY (CCA) (A3)	5-4
5-4 15 WATT POWER AMPLIFIER ASSEMBLY (A6)	5-4
Section III. FUNCTIONAL OPERATION OF MECHANICAL ASSEMBLIES	5-4
 CHAPTER 6.0 MAINTENANCE	 6-1
6-1 GENERAL	6-1
6-2 OPERATIONAL CHECKOUT	6-1
6-2.1 Power-up Verification	6-1
6-2.2 Display Off Control	6-1
6-2.3 Receive Tune Mode Verification	6-2
6-2.4 Transmit Tune Mode Verification	6-2
6-2.5 Fault LED	6-3
6-3 SERVICING	6-3
6-3.1 Servicing Intervals	6-3
6-3.2 Inspection	6-3
6-3.3 Preventive Maintenance	6-3
6-4 TROUBLESHOOTING	6-4
6-5 REMOVAL/REPLACEMENT PROCEDURES	6-10
6-5.1 Removal/Replacement Procedures - Operator	6-10
6-5.2 Removal/Replacement Procedures - Repair Specialist	6-12

CHAPTER 7.0 ILLUSTRATED PARTS BREAKDOWN..... 7-1

 Section I. INTRODUCTION 7-1

 7-1 GENERAL..... 7-1

 7-2 MAINTENANCE PARTS LIST. 7-1

 7-3 NUMERICAL INDEX..... 7-2

 7-4 REFERENCE DESIGNATION INDEX. 7-3

 7-5 ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES. 7-3

 7-6 CAGE CODE SUMMARY..... 7-4

 Section II. MAINTENANCE PARTS LISTS 7-10

 Section III. NUMERICAL INDEX 7-21

 Section IV. REFERENCE DESIGNATION INDEX..... 7-23

 Section V. COMMON BULK ITEMS LIST 7-24

CHAPTER 8.0..... 8-1

 8-1 SCOPE..... 8-1

GLOSSARY

ALPHABETICAL INDEX

LIST OF ILLUSTRATIONS

Figure 1-1.	Radio Set AN/TRC-199	1-0
Figure 1-2.	Receiver-Transmitter RT-1695/TRC-199	1-4
Figure 1-3.	Diplexer Front Panel (30-88 MHz)	1-4
Figure 2-1.	Packaging Diagram for the Tactical Repeater	2-2
Figure 2-2.	Antenna Mast/Antenna Installation (Sheet 1 of 6)	2-5
Figure 2-3.	Antenna Mast/Antenna Installation (Sheet 2 of 6)	2-6
Figure 2-4.	Antenna Mast/Antenna Installation (Sheet 3 of 6)	2-6
Figure 2-5.	Antenna Mast/Antenna Installation (Sheet 4 of 6)	2-7
Figure 2-6.	Antenna Mast/Antenna Installation (Sheet 5 of 6)	2-7
Figure 2-7.	Antenna Mast/Antenna Installation (Sheet 6 of 6)	2-8
Figure 4-1.	Location of Tactical Repeater Indicators, Controls and Switches	4-1
Figure 4-2.	Location of Power Supply Switches (Power Supply Top View)	4-3
Figure 4-3.	Location of Power Supply Connectors (Power Supply Side View)	4-4
Figure 4-4.	Location of Tactical Repeater Unit Connectors	4-5
Figure 4-5.	Location of Tactical Repeater Diplexer Controls	4-6
Figure 5-1.	Tactical Repeater System, Functional Block Diagram	5-2
Figure 5-2.	Repeater Control CCA (A3), Functional Block Diagram	5-5
Figure 5-3.	15 Watt Power Amplifier Assembly (A6), Functional Block Diagram	5-6
Figure 7-1.	Radio Set AN/TRC-199 (Sheet 1 of 2)	7-8
Figure 7-2.	Tactical Repeater Assembly (SS-4100806-501)	7-13
Figure 7-3.	Power Amp Assembly, 15W (SS-4100853-501)	7-19
FO-1	Radio Set AN/TRC-199, Interconnection Diagram	FP-1

LIST OF TABLES

Table 1-1.	Tactical Repeater Configurations (by Frequency Band)	1-3
Table 1-2.	Leading Particulars	1-5
Table 1-3.	Capabilities and Limitations	1-6
Table 1-4.	Equipment Supplied	1-7
Table 1-5.	Equipment Required But Not Supplied	1-8
Table 1-6.	Related Technical Manuals	1-8
Table 2-1.	Tactical Repeater Packaging	2-3
Table 2-2.	Tactical Repeater Interconnecting Cables	2-4
Table 2-3.	External Power Supply Switch Settings	2-9
Table 4-1.	Description of Indicators, Controls and Switches	4-2
Table 4-2.	Description of Power Supply Switches	4-3
Table 4-3.	Description of Power Supply Connectors	4-4
Table 4-4.	Description of Repeater Unit Connectors	4-5
Table 4-5.	Description of Diplexer Controls	4-6
Table 5-1.	Antenna System Frequency Band Vs Gain	5-3
Table 6-1.	Initial Switch and Control Settings for Power-Up Verification	6-1
Table 6-2.	Initial Switch and Control Settings for Receive Tune Mode Verification	6-2
Table 6-3.	Initial Switch and Control Settings for Transmit Tune Mode Verification	6-2
Table 6-4.	Recommended Service Intervals	6-3
Table 6-5.	Organizational Maintenance Guide - Operator	6-5
Table 6-6.	Organizational Maintenance Guide - Repair Specialist	6-9
Table 6-7.	Cross-Reference to Removal/Replacement Procedures	6-10
Table 7-1.	Radio Set AN/TRC-199	7-10
Table 7-2.	Tactical Repeater Assembly (SS-4100806-501)	7-15
Table 7-3.	Power AMP Assembly, 15W (SS-4100853-501)	7-20

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedure, and do not appear elsewhere in this manual. These Safety Summaries are recommended precautions that all personnel must understand and apply during any given phase of operation and maintenance. Each chapter has other specific warnings and cautions.

WARNING

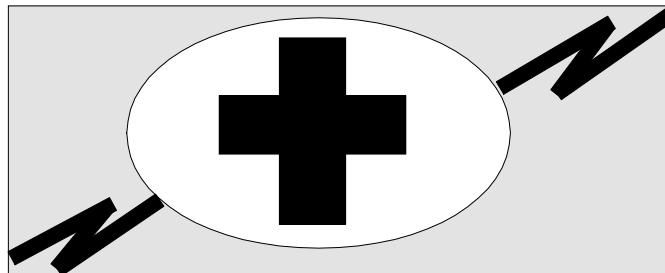
KEEP AWAY FROM LIVE CIRCUITS

Personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside equipment with power turned on. Under certain conditions, dangerous voltages may exist when the power switch is in the off position due to charges retained by capacitors. To avoid injury, always remove power and discharge and ground a circuit before touching it.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the Director of Base Medical Services.

WARNING



LITHIUM BATTERIES

Lithium oxide batteries or cells may be used in the receiver-transmitter used in this equipment. They are potentially hazardous if misused or tampered with before, during or after discharge. The following precautions must be strictly observed to prevent possible injury to personnel or equipment damage.

Do not heat, incinerate, crush, puncture, disassemble, or otherwise mutilate the batteries.

Do not short circuit, recharge, or bypass internal fuse.

Do not store batteries in equipment during long periods of non-use (in excess of 30 days).

Turn off the equipment immediately if you detect battery compartment becoming unduly hot, hear battery cells venting (hissing sounds), or smell irritating sulfur dioxide gas.

WARNING

VOLTAGES WITHIN THIS EQUIPMENT ARE HIGH ENOUGH TO ENDANGER LIFE.

Covers are *not* to be removed except by persons qualified and authorized to do so and these persons should always take extreme care once the covers have been removed.

Page

- 2-1 WARNING - Installation of the tactical repeater requires a minimum of two people.
- 2-1 WARNING - Removing the tactical repeater assembly from the shipping carton requires a minimum of two persons.
- 2-5 WARNING - Ensure proper use of safety tools (work gloves and hard hat) during assembly and disassembly of antenna.
- 2-6 WARNING - Before using the hammer, ensure a wedge is placed in the top of the hammer so that the hammer head does not come loose, thereby endangering personnel.
- 3-3 WARNING - Before performing removal/replacement procedures, make sure power is removed from unit. Failure to do so could result in personal injury or equipment damage.
- 6-10 WARNING - Before performing removal/replacement procedures, make sure power is removed from the unit by disconnecting from power source. Failure to do so could result in personal injury and equipment damage.
- 6-11 WARNING - This equipment is capable of generating RF power sufficient to cause RF burns. During transmit, care should be taken to eliminate the possibility of touching exposed RF output points such as the center conductors of coaxial cables or antenna feedpoints.
- 6-12 WARNING - Before performing removal/replacement procedures, make sure power is removed from the unit. Failure to do so could result in personal injury or equipment damage.
- 2-1 CAUTION - Exercise care when removing units from packing material in order to prevent damage to the unit.
- 3-3 CAUTION - Never apply pressure sensitive tape directly to connectors. This could damage connector pins.
- 3-3 CAUTION - Package all electrostatic discharge (ESD) sensitive assemblies in ESD bags before shipping or storing.
- 3-3 CAUTION - Rough handling may cause unnecessary damage to electronic assemblies.
- 3-3 CAUTION - Electronic assemblies containing solid-state devices are susceptible to damage from static electrical discharges. Wear protective clothing and grounded wrist straps.
- 3-3 CAUTION - Forcing any tilted or cocked electronic assembly into position may result in bent or broken pins.
- 3-4 CAUTION - When repairing an electronic assembly, be careful that the tool employed does not inadvertently press against leads, pins, or other parts that are easily bent.

Page

- 3-4 CAUTION - Because of the miniaturization of parts for electronic assembly construction, the leads, connectors, and pins have been stiffened to make them more rugged. As a result, such parts are brittle and will break easily if bent too often or pulled on too hard. When handling an assembly that has been removed from its chassis, be careful not to press against the leads and pins. When removing an assembly, be sure to pull it straight out from the equipment. Do not cock, twist, pry, or carelessly jerk an electronic assembly to remove it from the mounting or connector.
- 3-4 CAUTION - The tactical repeater contains components that are susceptible to damage by static electrical charges. Disassembly of the tactical repeater should only be done at a properly grounded work station.
- 6-12 CAUTION - The tactical repeater contains components that are susceptible to damage by static electrical charges. Disassembly of the tactical repeater should only be done at a properly grounded work station.

FOREWORD

This manual meets the technical content requirements of specification MIL-M-38798B, paragraph 3.3 (1 December 1975) and MIL-M-38807A (1 June 1982) and format requirements of specification MIL-M-38784B (16 April 1983) for the tactical repeater.

- a. Chapter 1 - General Information. This chapter provides general information for the tactical repeater including equipment description and purpose, leading particulars, capabilities and limitations, equipment supplied, equipment required but not supplied, optional equipment, special tools and test equipment, and related technical manuals.
- b. Chapter 2 - Installation. This chapter provides complete installation instructions for the receiver-transmitter including installation logistics and installation procedure.
- c. Chapter 3 - Preparation for Use and Reshipment. This chapter contains information which will permit operation and maintenance personnel to prepare the equipment for use, including reference to post-installation checkout procedures, preparing the unit for reshipment, packing, handling, and storage procedures.
- d. Chapter 4 - Operation. This chapter provides complete operating instructions for the tactical repeater.
- e. Chapter 5 - Theory of Operation. This chapter provides complete theory of operation for the tactical repeater.
- f. Chapter 6 - Maintenance. This chapter provides all instructions required for on-equipment and off-equipment maintenance of the tactical repeater. Includes preventive maintenance, troubleshooting procedures, and repair procedures.
- g. Chapter 7 - Illustrated Parts Breakdown (IPB). Provides complete illustrated parts breakdown for the tactical repeater. The IPB is prepared in accordance with MIL-M-38807A.
- h. Chapter 8 - Circuit Diagrams. Contains interconnection diagram.
- i. Glossary - Provides a definition of the special terms and abbreviations used in the technical order.
- j. Alphabetical Index - Provides cross-references to applicable paragraphs, figures or tables.

Legend for Figure 1-1:

1. Receiver-Transmitter RT-1695/TRC-199 Unit (A4, A5)
2. Tactical Repeater (TR) Assembly (A1)
3. Weldment, Repeater Frame
4. Power Supply (A2) (includes Power Supply Enclosure and Battery Enclosure)
5. Cable Assembly, TR PS Power (W1)
6. Diplexer Assembly, 30-88 MHz (A3)
7. Diplexer Assembly, 136-174 MHz (A3)
8. Diplexer Assembly, 403-470 MHz (A3)
9. Not Used
10. Antenna, 30-88 MHz
11. Antenna, 136-174 MHz
12. Antenna, 403-470 MHz
13. Antenna, Mast, TR
14. Case, Transceiver Module
15. Strap Assembly, Ground (W5)
16. Strap Assembly, Ground (W6)
17. Strap Assembly, Ground (W7)
18. Rod Assembly, Ground
19. Cable, Coaxial, Antenna (W10)
20. Cable Assembly, TR, 120 VAC, Power (W9)
21. Cable Assembly, TR, 240 VAC, Power (W9)
22. Cable Assembly, TR, 10-32 VDC, Power (W9)
23. Case, Transit, Diplexer
24. Case, Transit, Diplexer
25. Cover, Frame
26. Cable Assembly, Coaxial, RF (W2)
27. Cable Assembly, Coaxial, RF (W3)
28. Cable Assembly, Coaxial, RF (W4)

Figure 1-1. Radio Set AN/TRC-199
(Sheet 1 of 3)

Figure 1-1. Radio Set AN/TRC-199
(Sheet 2 of 3)

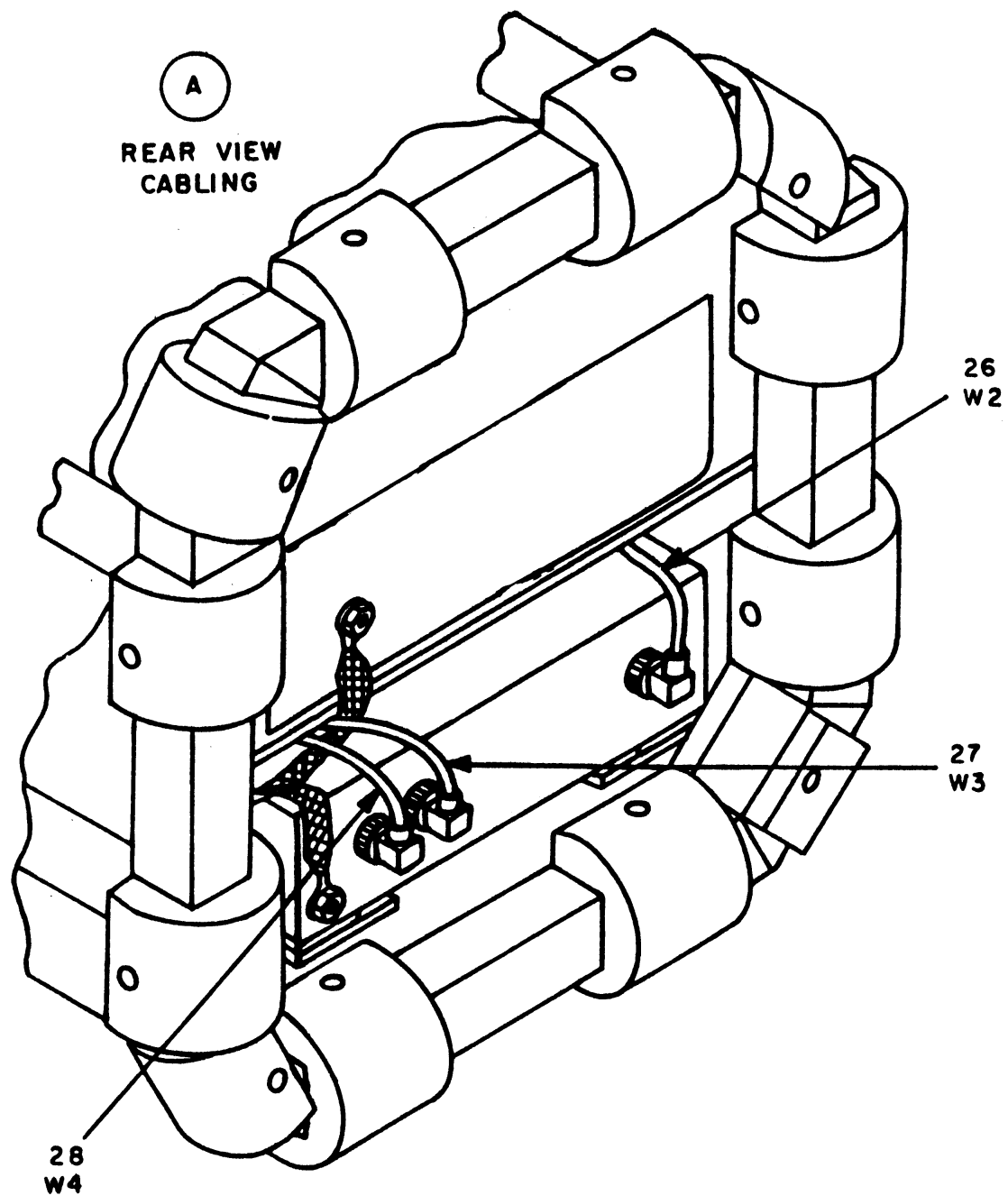


Figure 1-1. Radio Set AN/TRC-199
(Sheet 3 of 3)

CHAPTER 1.0 GENERAL INFORMATION

1-1 DESCRIPTION AND PURPOSE.

1-1.1 Equipment Function and Purpose.

Radio Set AN/TRC-199 (hereinafter referred to as the tactical repeater) is a communications unit capable of operating in the 30-88, 136-174, or 403-470 Megahertz (MHz) frequency bands. It is used to extend the communications range of fixed, mobile, or portable receiver-transmitters. The tactical repeater is COMSEC transparent and provides repeater capability for all modes without the need for COMSEC encryption/decryption.

1-1.2 Equipment Description.

(See Figure 1-1.) The tactical repeater includes a tactical repeater assembly, two non-CCI Receiver-Transmitter Sets, Radio RT-1695/TRC-199 (hereinafter referred to as the receiver-transmitters), three antenna systems, an antenna mast, three diplexers, a tubular (weldment) frame, a power supply enclosure, and a battery enclosure.

1-1.2.1 Tactical Repeater Assembly.

(See Figure 7-2.) The tactical repeater assembly includes two circuit card assemblies (CCAs) which are accessible through a removable cover on the underside of the unit. These are the +15 volt (V) DC-DC converter CCA (A1) and repeater control CCA (A3). These CCAs plug into the parent board (A4) which interfaces with control panel assembly (A5), power amplifier assembly (A6), +28V DC-DC converter CCA (A7), the external power supply, and the plug-in receiver-transmitters. The receiver-transmitters plug into sleeves (A8, A9) located on the left and right sides of the front panel of the tactical repeater assembly. The power amplifier (A6) mounts on a heatsink on top of the tactical repeater unit.

1-1.2.2 Receiver-Transmitters.

(See Figure 1-2.) The receiver-transmitters provide transmit/receive communication in the 30-88, 136-174, or 403-470 MHz frequency bands. The operating band of the receiver-transmitters is determined by the transceiver module installed. When the transceiver modules are changed, the tactical repeater must be fitted with the proper antenna and diplexer. The proper configurations are listed in Table 1-1.

Table 1-1. Tactical Repeater Configurations (by Frequency Band)

Frequency Band	Receiver-Transmitter	Antenna	Diplexer
30-88 MHz	SS-4100820-501	4242-MK2-RAC	SS-1600322-501
136-174 MHz	SS-4100821-501	4265-RAC	SS-1600322-502
403-470 MHz	SS-4100822-501	4266-RAC	SS-1600322-503

NOTE

The CCI Receiver-Transmitter RT-1696/U(C) shall not be used in the tactical repeater.

1-1.2.3 Antenna Assembly.

The antenna system for the tactical repeater provides full-duplex transmit and receive capability over one of three bands of operation. The selected antenna is mast mounted. Three antennas are provided to cover the three bands of operation. Refer to Table 1-1. A mast is provided to elevate the selected antenna up to 10 feet (in 5 foot increments) to increase transmission range and quality of transmitted and recorded signals.

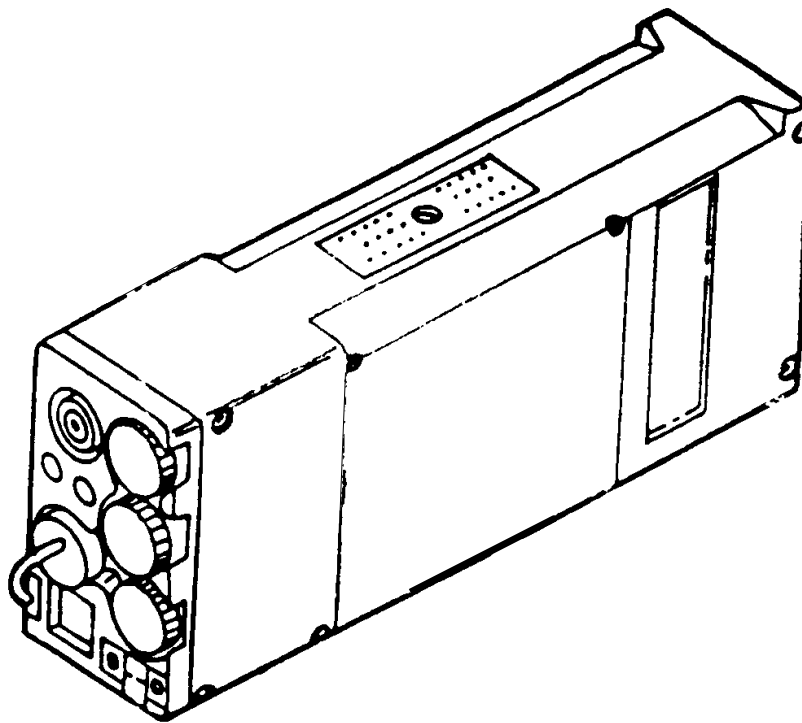


Figure 1-2. Receiver-Transmitter RT-1695/TRC-199

1-1.2.4 Diplexer.

(See Figure 1-3.) The tactical repeater diplexer provides a method of using a receiver and a transmitter on a common antenna. The diplexer, when properly tuned, provides a transmitter-to-receiver isolation of 70 decibels (dB) at any frequency spacing of 4 MHz or 3% of the operating frequency, whichever is greater. The diplexer has an insertion loss of less than 2.25 dB between the transmit port and the antenna and less than 3.0 dB between the receive port and the antenna. The diplexer is capable of handling 60 watts of radio frequency (RF) power in the transmit path and provides protection at the receive port to limit receive signals to a maximum level of +33 power in decibels (referenced to 1 milliwatt) (dBm). There are three separate diplexers, one for each frequency band. The frequency band of the diplexer must correspond to that of the receiver-transmitter and antenna.

Legend for Figure 1-3 (136-174 MHz and 403-470 MHz diplexers have the same controls, but their appearance is slightly different):

1 Tuning Meter 2. SENS Control 3. RCV Control 4. XMT Control 5. TUNE Switch

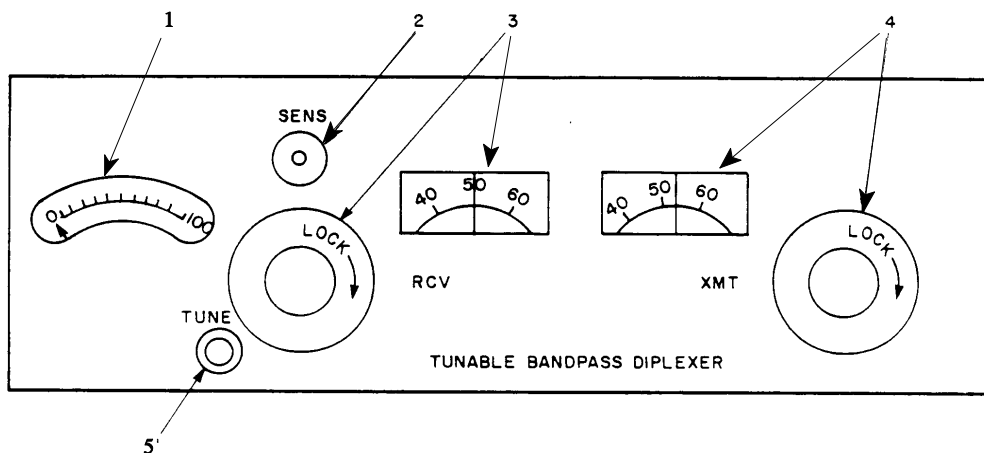


Figure 1-3. Diplexer Front Panel (30-88 MHz)

1-1.2.5 Power Supply Assembly.

The power supply assembly provides power for the operation of the tactical repeater. The power supply will operate from any direct current (DC) voltage between 10 and 32 volts and from 120/240 or 220 volts alternating current (VAC). The operation of the power supply is controlled by AC/OFF/DC and internal/external (INT/EXT) DC switches on the power supply. The power supply assembly consists of the power supply enclosure and the battery enclosure.

1-1.2.5.1 Power Supply Enclosure.

The power supply enclosure provides regulated DC power to the tactical repeater assembly.

1-1.2.5.2 Battery Enclosure.

The battery enclosure is a weather-resistant container that can hold either four Lithium batteries (Type BA-5590/U) or four NiCad batteries (Type BB-590/U). The battery connectors are mounted in the bottom of the battery enclosure box. (For battery installation see paragraph 2-10.2.)

1-2 LEADING PARTICULARS.

Leading particulars for the tactical repeater are given in Table 1-2.

Table 1-2. Leading Particulars

Characteristic	Parameter
Equipment dimensions and weight:	
Length	28.00 inches (in.) (71.1 centimeters (cm))
Width	18.50 in. (47.0 cm)
Height	18.50 in. (47.0 cm)
Volume	9,583 cubic in. (157,037 cubic cm)
Weight	130.0 pounds (lbs) (58.97 kilograms (kg))
Environmental requirements:	
Temperature:	
Operating	-40° Celsius (C) (-40° Fahrenheit (F)) to +49°C (120°F)
Storage	-51°C (-60°F) to +68°C (155°F)
Humidity	0 to 95 percent relative humidity
Electrical power requirements	10V to 32V DC Battery Power 120/240 " 10% (1 phase, 3 wire) at 50/60 Hertz (Hz) 220 VAC " 10% (1 phase, 3 wire) at 50 Hz

1-3 CAPABILITIES AND LIMITATIONS.

Capabilities and limitations of the tactical repeater are given in Table 1-3.

Table 1-3. Capabilities and Limitations

Characteristic	Parameter
Frequency Range (RCV and XMT)	30-88 MHz 136-174 MHz 403-470 MHz
Transmitter Output	2 and 10 watts selectable
Security	Tactical repeater is COMSEC transparent
Interoperability	AN/PRC-77 Manpack Radio Radio Set AN/PRC-128 SINGARS-V (single channel) FED-STD-1023 compatible, 12 kbps VINSON (KY-57) compatible, 16 kbps Analog 25 MHz frequency modulated (FM) radios
Receiving/Transmitting	25 kilohertz (kHz) Bandwidth on all frequency bands. 12.5 kHz intermediate frequency (IF) Bandwidth on 136-174 MHz and 12.5 kHz channel spacing on 403-470 MHz bands 12.5 kHz tuning steps
Channels (receive and transmit)	14 channels each programmable with frequency bandwidth, output power, and squelch tones (continuous-tone controlled squelch system (CTCSS)) as variables
Adjacent Channel Selectivity	50 dB over 30-88 MHz, 25.0 kHz bandwidth 52 dB over 136-174 MHz, 12.5 kHz bandwidth 60 dB over 136-174 MHz, 25.0 kHz bandwidth 40 dB over 403-470 MHz, 12.5 kHz bandwidth 48 dB over 403-470 MHz, 25.0 kHz bandwidth
Sensitivity	-113 dBm or 0.50 μ V for 12 dB signal + noise + distortion/noise + distortion (SINAD)
Spurious Response and Image Rejection	65 dB over all bands
Intermodulation Spurious Response	60 dB over 30-88 MHz 60 dB over 136-174 MHz 60 dB over 403-470 MHz

1-4 EQUIPMENT SUPPLIED.

Equipment supplied with Radio Set AN/TRC-199 is listed in Table 1-4.

Table 1-4. Equipment Supplied

Official Nomenclature	Part Number	Quantity
Tactical Repeater Assembly	SS-4100806-501	1
Power Supply Assembly	SS-4100733-501	1
Power Supply Enclosure		
Battery Enclosure		
Diplexer Assembly, 30-88 MHz	SS-1600322-501	1
Diplexer Assembly, 136-174 MHz	SS-1600322-502	1
Diplexer Assembly, 403-470 MHz	SS-1600322-503	1
Antenna, 30-88 MHz	4242-MK2-RAC	1
Antenna 136-174 MHz	4265-RAC	1
Antenna, 403-470 MHz	4266-RAC	1
Mast, Antenna Tactical Repeater	SP10SS	1
Case, Transceiver	SS-3100552-501	1
Ground Rod Assembly	SS-3100551-501	1
Receiver/Transmitter Set,	SS-4100807-512	2
Radio RT-1695/TRC-199	SS-4100819-502	2
Transceiver Module, 30-88 MHz	SS-4100820-501	2
Transceiver Module, 136-174 MHz	SS-4100821-501	2
Transceiver Module, 403-470 MHz	SS-4100822-501	2
Cable Assembly, Tactical Repeater Power	SS-4500110-501	1
Cable Assembly, Coaxial, RF	SS-3500292-501	1
Cable Assembly, Coaxial, RF	SS-3500292-502	1
Cable Assembly, Coaxial, RF	SS-3500292-503	1
Strap Assembly, Ground	SS-3500279-502	1
Strap Assembly, Ground	SS-3500279-503	1
Strap Assembly, Ground	SS-3500279-504	1
Cable Assembly, Power Supply, 120 VAC Input	SS-4500107-501	1
Cable Assembly, Power Supply, 240 VAC Input	SS-4500108-501	1
Cable Assembly, Power Supply, DC	SS-4500109-501	1
Cable Assembly, Coaxial, Antenna	CPRG223/U-30-XX	1
Bumpers, Tactical Repeater Frame	SS-3400353-1	24
Bushing, Shock Mount	SS-2400577-1	8
Clamp, Rear	SS-3100546-501	1
Clamp, Front	SS-3400355-1	1
Frame, Weldment	SS-4400225-1	1
Case, Transit, Diplexer	275-160-100-08	1
Cover, Frame	IC-3300RC	1

1-4.1 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-5 lists equipment required but not supplied.

Table 1-5. Equipment Required But Not Supplied

Equipment	Part Number
Programmer Unit, Frequency Radio MX-11531/U	SS-4100797-501
Batteries	Lithium Type BA-5590/U NiCad Type BB-590/U
NiCad Battery Charger/Conditioner	MRC-590

1-5 SPECIAL TOOLS AND TEST EQUIPMENT.

There are no special tools or test equipment required for maintenance.

1-6 RELATED TECHNICAL MANUALS.

Table 1-6 lists related technical manuals.

Table 1-6. Related Technical Manuals

Publication Number	Publication Title
31R2-2PRC139-1	Operation and Maintenance Instructions with Illustrated Parts Breakdown (Organizational Level) for Radio Set AN/PRC-139(C) (includes RT-1695/TRC-199, RT-1696/U (C), Programmer Unit, Frequency, Radio MX-11531/U, Battery Chargers, and Battery Reconditioner)
31R2-2GRC238-1	Operation and Maintenance Instructions with Illustrated Parts Breakdown (Organizational Level) for Radio Set AN/GRC-238
31R2-4-1085-1	Operation and Maintenance Instructions with Illustrated Parts Breakdown (Organizational Level) for Adapter Group OF-228/U
31R2-2PRC-139-06	Work Unit Code Manual
TO 35C3-2-113-2	NiCad Battery Reconditioner, MRC-590

CHAPTER 2.0 INSTALLATION

2-1 INTRODUCTION.

This section is divided into two sections. Section I. Installation Logistics provides information for site preparation, unloading, unpacking, and inspections, housing, receiving data, material handling, cabling, and buildings and other structures. Section II. Installation Procedures lists tools and equipment required for field installation and describes the installation sequence.

Section I. INSTALLATION LOGISTICS

WARNING

Installation of the tactical repeater requires a minimum of two people.

2-2 SITE PREPARATION.

Select an operating site that is free of obstruction and has access to one of the electrical power sources specified in Table 1-2. The selected operating area must have sufficient room to accommodate the 9583 cubic inch volume of the tactical repeater assembly. The antenna should be at least two antenna lengths (e.g., 44 feet for 30-88 MHz) from power lines and other antennas, etc.

2-3 UNPACKING AND INSPECTIONS.

CAUTION

Exercise care when removing units from packing material in order to prevent damage to the unit.

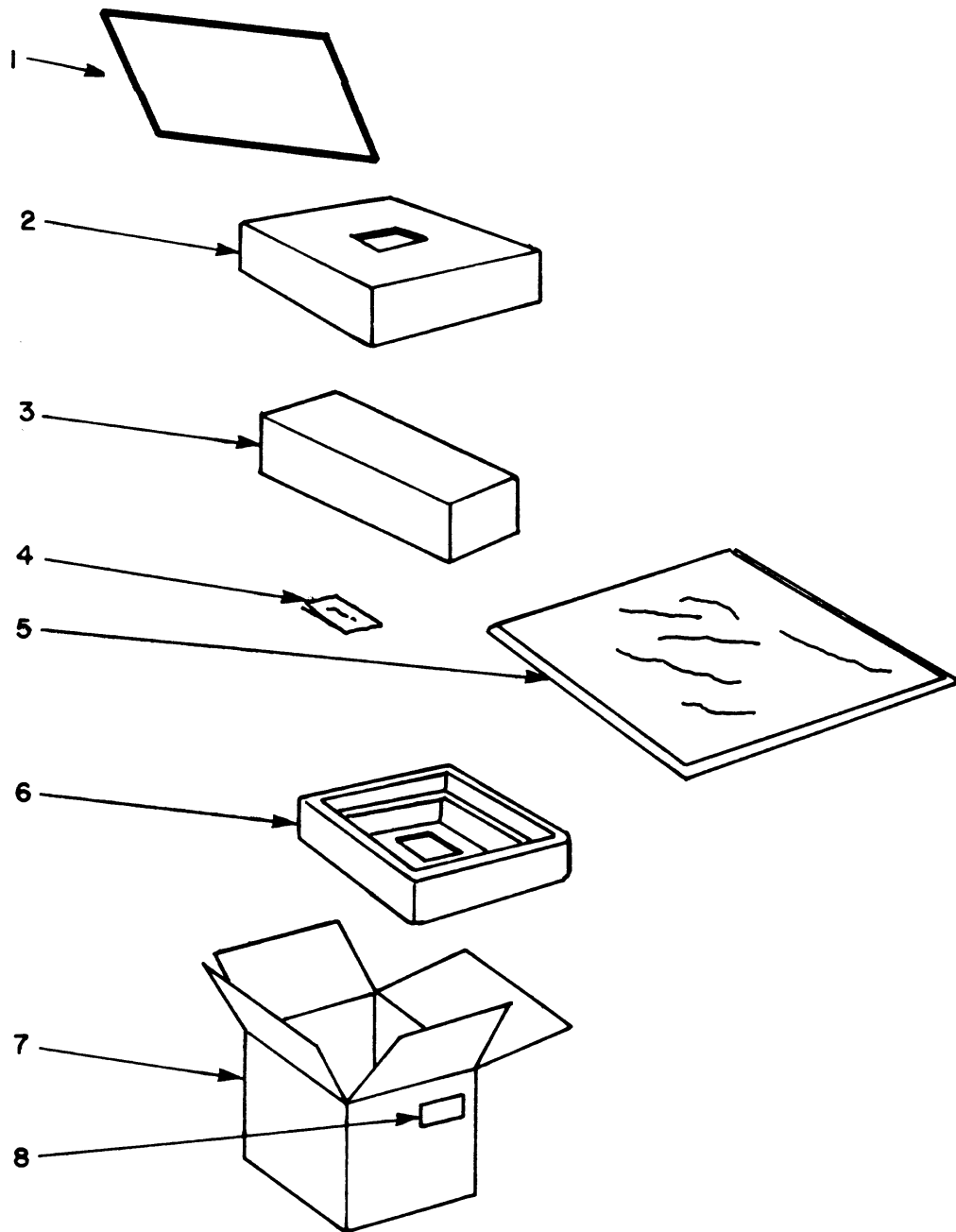
WARNING

Removing the tactical repeater assembly from the shipping carton requires a minimum of two persons.

To unpack the tactical repeater, remove the unit and any equipment from the carton and store the packing and carton for reuse/shipment. Packing instructions are given in Chapter 3. Inspect contents for completeness, integrity, and damage. Contents shall be in accordance with the packing slips and the list of supplied equipment in Table 1-4.

Refer to Figure 2-1 as a guide in performing the following unpacking procedures:

- a. Open top of the fiberboard box (7, Figure 2-1) and remove the polystyrene top piece (2) from box.
- b. Remove barrier bag (5) from the box.
- c. Remove the tactical repeater assembly (3) from barrier bag (5).
- d. Remove packing slip (8) from the plastic envelope on the fiberboard box and check to ensure that all items listed on the packing slip were received.



Legend for Figure 2-1:

- | | | | |
|----|----------------------------|----|--------------------|
| 1. | Operating instructions | 5. | Barrier bag |
| 2. | Polystyrene top | 6. | Polystyrene bottom |
| 3. | Tactical repeater assembly | 7. | Fiberboard box |
| 4. | Desiccant bag | 8. | Packing slip |

Figure 2-1. Packaging Diagram for the Tactical Repeater

- e. Store all packing materials (except the desiccant bag) in shipping container and store shipping container for re-use. New desiccant material must be used when repacking.
- f. Inspect top and bottom, both sides, and front and rear panels of equipment for dents, scratches or any visually identifiable damage.
- g. Inspect controls and indicators on control panel for missing, broken or cracked knobs or levers and note any discrepancies on Receiving Report, DD Form 1348-1. Report any discrepancies in accordance with standard internal receiving procedures.

2-4 HOUSING.

If necessary to store the tactical repeater for any period of time before installation, proceed as follows:

- a. Clean the tactical repeater before placing in storage, if necessary. Refer to paragraph 6-3.3.2.
- b. Disconnect antennas and accessories before placing the tactical repeater in storage.
- c. Remove receiver-transmitters from the tactical repeater before placing in storage.
- d. Remove batteries.

NOTE

The temperature of the storage area must be within the range -51°C (-60°F) to +68°C (155°F).

2-5 RECEIVING DATA.

Table 2-1 identifies the contents of the shipping container.

Table 2-1. Tactical Repeater Packaging

Box	Description	Dimensions (in)			Weight (lb)
		W	D	L	
1	Tactical Repeater Assembly	34.625	68	33.75	195

2-6 MATERIAL HANDLING.

The weight of the equipment is such that a minimum of two persons are required to lift the equipment.

2-7 CABLES.

Table 2-2 lists all tactical repeater interconnecting cables.

Table 2-2. Tactical Repeater Interconnecting Cables

Cable Designation	Cable Part No.	Description	Use
W1	SS-4500110-501	Cable Assembly, TR Power	Connects power supply DC output to tactical repeater
W2	SS-3500292-501	Cable Assembly, Coaxial, RF	Connects diplexer receiver (RX) output to tactical repeater assembly
W3	SS-3500292-502	Cable Assembly, Coaxial, RF	Connects diplexer transmitter (TX) output to tactical repeater assembly
W4	SS-3500292-503	Cable Assembly, Coaxial, RF	Connects diplexer antenna (ANT) output to RF IN of power supply
W5	SS-3500279-502	Strap Assembly, Ground	Connects tactical repeater assembly to external ground
W6	SS-3500279-503	Strap Assembly, Ground	Connects diplexer to external ground
W7	SS-3500279-504	Strap Assembly, Ground	Connects power supply to external ground
W9	SS-4500107-501	Cable Assembly, Power Supply, 120 VAC Input	Connects tactical repeater to 120 VAC
W9	SS-4500108-501	Cable Assembly, Power Supply, 240 VAC Input	Connects tactical repeater to 240 VAC
W9	SS-4500109-501	Cable Assembly, Power Supply, DC	Connects tactical repeater to 10-32 VDC
W10	SS-1600315-1	Cable Assembly, Coaxial, Antenna	Connects antenna to antenna connector of tactical repeater power supply

2-8 BUILDING AND OTHER SUPPORTING STRUCTURES.

Not Applicable.

Section II. INSTALLATION PROCEDURES

2-9 SPECIAL TOOLS AND EQUIPMENT REQUIRED FOR FIELD INSTALLATION.

No special tools or equipment are needed for installation and initial setup of the tactical repeater.

2-10 INSTALLATION SEQUENCE.

(See FO-1.) Perform the following procedure to install the tactical repeater. Cables required for installation are listed in Table 2-2. FO-1 illustrates the required cable connections.

2-10.1 Antenna/Mast Installation.

(Refer to Figure 2-2.) Install the antenna mast and selected antenna as follows:

CAUTION

Ensure proper use of safety tools (work gloves and hard hat) during assembly and disassembly of antenna and mast.

NOTE

The tactical repeater assembly is shipped from the factory configured for 30-88 MHz operation, with the appropriate receiver-transmitters and diplexer. If using a different configuration, substitute the appropriate antenna, receiver-transmitters, and diplexer. Refer to Chapter 6 for antenna and diplexer removal and replacement. Refer to TO 31R2-2PRC139-1 for changing receiver-transmitter configuration.

NOTE

The assembled antenna base section/antenna adapter will fit in the mast transit bag (3) so that step a may be carried out prior to field deployment, if required. When erecting the antennas in high winds, ensure that a minimum of three personnel are used.

- a. Bolt the antenna base section (1, Figure 2-2) to the antenna adapter (2) and connect the antenna ground strap to its terminal.
- b. Select an unobstructed site. Under windy conditions mast raising is made easier if the mast is laid out on the ground with the base of the mast pointed into wind.

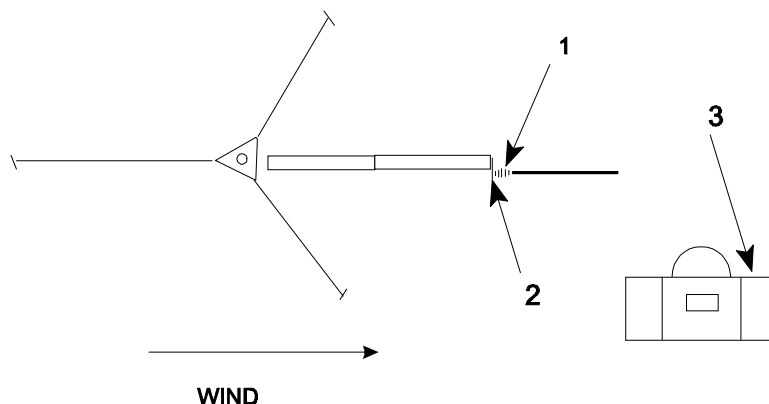


Figure 2-2. Antenna Mast/Antenna Installation (Sheet 1 of 6)

- c. Remove both mast sections from the transit bag (3). Note that the socketed end is the lower end of each section. Place the tubes in line along the ground. Assemble the two tube sections together.
- d. Remove the base plate (4), two ground spikes (5), and hammer from the transit bag. Place the base plate at the mast base, arrowhead style, so that the socketed lower end of the mast will engage in the heel. Secure the base plate by driving the two ground spikes through the holes.

WARNING

Before using the hammer, ensure a wedge is placed in the top of the hammer so that the hammer head does not come loose, thereby endangering personnel.

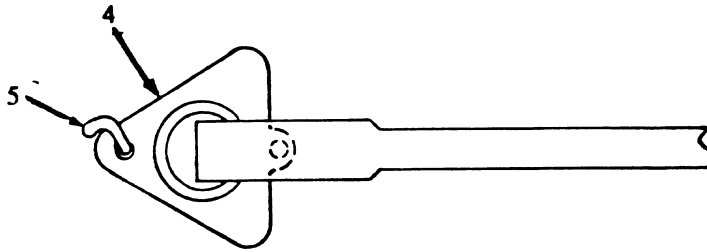


Figure 2-3. Antenna Mast/Antenna Installation (Sheet 2 of 6)

- e. Fasten the antenna/adaptor assembly to the top antenna section. Connect the top coaxial cable connector to the antenna and attach cable strain relief to hole in web of adaptor. Rest flat edge of adaptor on ground to provide convenient access to guy rope attachment points. Unwind cable along length of mast and secure to mast at centers of each section. Secure using cable clamps.

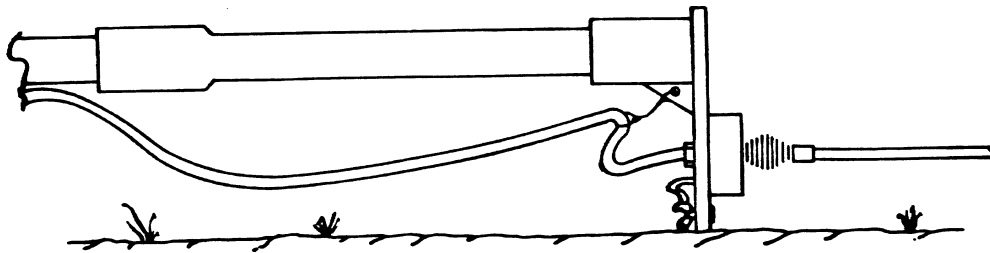


Figure 2-4. Antenna Mast/Antenna Installation (Sheet 3 of 6)

- f. Remove three guy rope assemblies (6) and three ground anchors (7) from the transit bag. Disconnect the first (fixed) snap hook off the winder and temporarily connect it to the base plate. Carrying the hammer and one of the ground anchors, walk away in the exact opposite direction to the mast (i.e., in the direction that the arrow head is pointing) unwinding the guy rope as you go, until the ground anchor radius marker is reached. Drive in the ground anchor at this point ensuring that it leans away from the mast (approximately 20° from vertical).

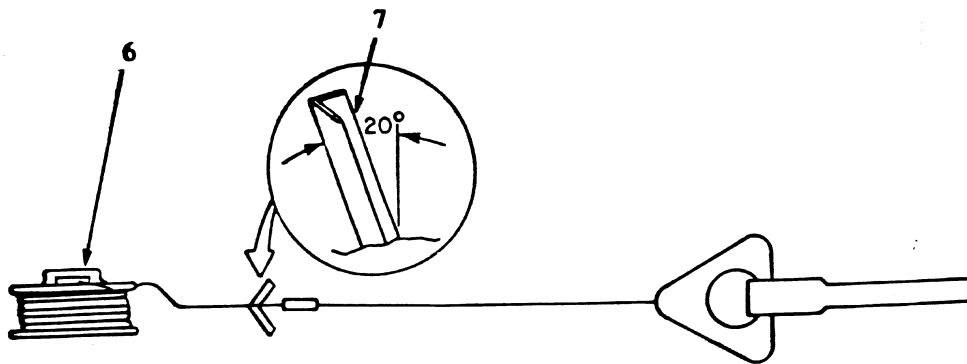


Figure 2-5. Antenna Mast/Antenna Installation (Sheet 4 of 6)

- g. Using the same guy rope as a radius guide, walk across to the approximate location of the second ground anchor. Establish the required 120° from the first ground anchor by using the triangular shape of the base plate as a reference. Drive in a second ground anchor at this point.

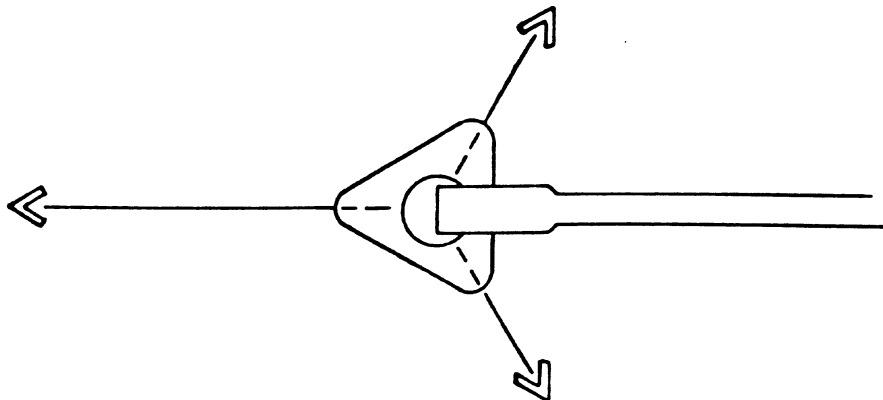


Figure 2-6. Antenna Mast/Antenna Installation (Sheet 5 of 6)

- h. Repeat step g for the third ground anchor.
- i. Disconnect the guy rope used for a radius marker. Attach the fixed (upper) snap hook to the attachment point on the antenna adapter. Attach the running hook at the lower end to ground anchor 2. Note that the winder remains attached to the lower ends of the guy rope to prevent accidental loss.
- j. Take a second guy rope. Attach the fixed (upper) snap hook to the antenna adapter attachment point. Attach the running hook at the lower end to ground anchor 3.
- k. Attach the upper snap hook of the third guy rope to the adapter attachment point. Unwind the rope along the length of the mast toward the ground anchor 1, but do not attempt to attach the lower end yet. Ensure that guy ropes will not snag coaxial cable when mast is raised.

- l. Ensure foot of mast is securely located in the base plate heel. While person a pushes up mast head Iwo Jima style, person b pulls on guy ropes to raise mast to vertical. Person a should progressively walk towards bottom of mast as it is raised and should hold mast steady as it reaches the vertical. Person b attaches free guy ropes to ground anchor 1 and tightens all ropes.
- m. Connect the 30-88 MHz antenna (SS-1600230-1) to the connector at the back of the power supply using the coaxial antenna cable (SS-1600315-1). Refer to FO-1.

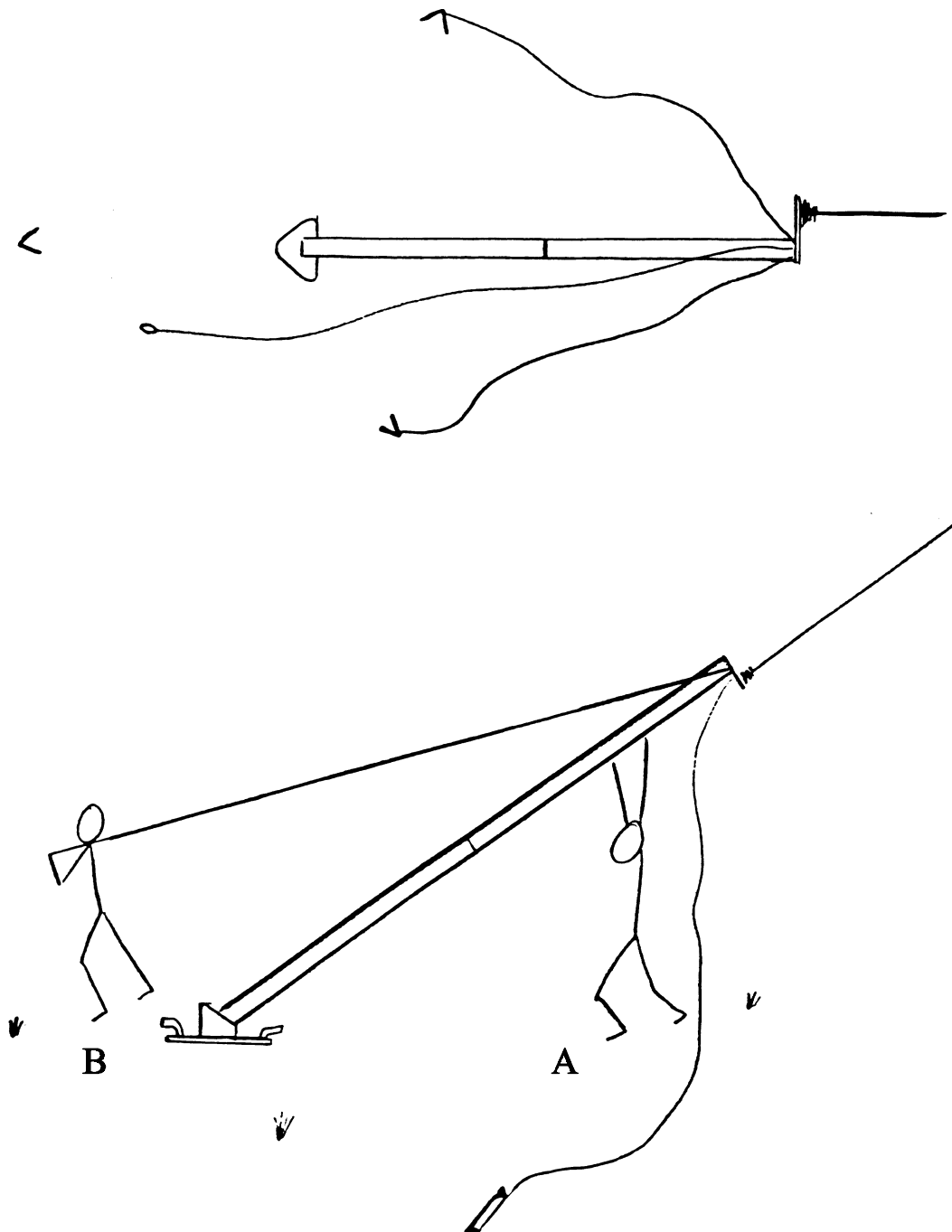


Figure 2-7. Antenna Mast/Antenna Installation (Sheet 6 of 6)

2-10.2 Lithium Battery Installation.

(Optional) (This procedure is also applicable to the Type BB-590/U NiCad batteries.) The battery enclosure has connectors for four type BA-5590/U Lithium batteries. The connectors are mounted in the bottom of the enclosure. To install the batteries, first open the battery enclosure. Taking each battery, in turn, turn the battery so that the connector is facing down, align the connector on the battery with the connector in the bottom of the enclosure, and push down on the battery until seated.

To power the tactical repeater from the installed batteries, set the power supply POWER switch to DC, and the DC SEL switch to INT. The repeater is capable of full operation with either three or four batteries installed.

2-10.3 Ground Rod Installation.

The ground rod assembly consists of a 3 foot long ground rod and an attached 10 foot grounding strap. The grounding strap ends in a spade lug that is connected to a ground screw on the tactical repeater assembly frame next to the power supply assembly.

To install, place the tactical repeater in its selected operating location. Locate the ground lug on the frame and select a spot for the ground rod within a 10 foot arc of the ground screw. Drive the ground rod into the ground with a sledge hammer until the grounding strap clamp is level with the ground. Remove the wing nut and washer from the ground screw, place the spade lug over the screw, and reattach the washer and wing nut.

2-10.4 External Power Supply.

To connect the tactical repeater to an external power supply, select the appropriate power supply cable to match the external source (110/220 VAC, 240 VAC, or 10-32 VDC). Connect the power supply cable to the POWER IN connector on the power supply and connect to the power source. Set the power supply POWER switch and DC SEL switch as indicated in Table 2-3.

Table 2-3. External Power Supply Switch Settings

POWER SOURCE	POWER	DC SEL
110/220 VAC	AC	N/A
240 VAC	AC	N/A
10-32 VDC	DC	EXT

2-10.5 Diplexer Installation.

Refer to paragraph 6-5.1.6.

2-10.6 Receiver-Transmitter Transceiver Module Installation.

Refer to TO 31R2-2PRC139-1.

CHAPTER 3.0 PREPARATION FOR USE AND RESHIPMENT

3-1 INTRODUCTION.

This chapter is divided into two sections. Section I. Preparation For Use provides post-installation operational checks that must be performed prior to operating the tactical repeater. Section II. Preparation For Reshipment contains procedures for reshipment of the unit.

Section I. PREPARATION FOR USE

3-2 INSPECTION.

If the tactical repeater has not been inspected as part of the installation process, or if the equipment has not been used recently, check to ensure that all cable connections are tight and no damage is visible on the exterior of the tactical repeater.

3-3 POST-INSTALLATION CHECKOUT.

3-3.1 Preliminary.

Before performing the post-installation checkout procedures of paragraph 3-3.3, perform the following preliminary procedure.

- a. Ensure that both receiver-transmitters (SS-4100807-512) have been programmed with the correct frequencies and squelch. (TO 31R2-2PRC139-1 describes procedures for programming all programmable parameters. All necessary programming must be performed prior to inserting the receiver-transmitters in the tactical repeater.)
- b. Ensure that the mode switches on both receiver-transmitters are set to CLR and the SCAN switch is turned off.

NOTE

Other programmable parameters may be set to any value.

NOTE

Be sure to align the receiver-transmitters so that the orientation of the control knobs and connectors corresponds to the markings on the sleeve door. The receiver-transmitters cannot be inserted in the tactical repeater with the battery attached.

- c. Insert the receiver-transmitter (SS-4100807-512) for the transmit frequency into the right sleeve of the tactical repeater, with the side connectors facing up (refer to Figure 1-1). Turn the cam above the receiver-transmitter clockwise until it locks (1/4 turn).
- d. Insert the receiver-transmitter (SS-4100807-512) for the receive frequency into the left sleeve of the tactical repeater, with the side connector facing up (refer to Figure 1-1). Turn the cam above the receiver-transmitter clockwise until it locks (1/4 turn).
- e. Place the DISPLAY switch in the ON position to verify proper installation. Place the power supply AC/DC POWER switch in either AC or DC position, depending on the source of power. If DC is selected, the DC SEL switch must be set for either internal (INT) or external (EXT) DC power source. Confirm that the POWER light emitting diode (LED) is illuminated green and the FAULT LED is not illuminated.

3-3.2 Alignment and Adjustment.

The tactical repeater is aligned and adjusted for normal operation at the factory/depot. No other alignments or adjustments are authorized or required. The diplexer will require retuning as described in paragraph 4-3 whenever the transmit or receive frequencies are changed.

3-3.3 Post-Installation Checkout Procedures.

After completion of installation, perform the following checkout procedures.

3-3.3.1 Power-Up Check.

Perform the power-up check as follows:

- a. Ensure the receive receiver-transmitter is programmed with the proper type squelch settings to receive the desired modulation format (carrier squelch or CTCSS tones).
- b. Place the tactical repeater MODE SELECT switch (6, Figure 4-1) in the OP2WATT or OP10WATT position.
- c. Place the power supply AC/DC POWER switch (1, Figure 4-2) in either AC or DC position, depending on source of power. If DC is selected, the DC SEL switch must be set for internal (INT) or external (EXT) power source, as appropriate.
- d. Ensure that the green POWER LED is illuminated when the DISPLAY switch is ON. This indicates that the unit is receiving power from the power converter.

3-3.3.2 Operational Check.

Perform the operational checkout included in paragraph 6-2 to verify that the major components of the tactical repeater are properly functioning.

3-3.3.3 Equipment Shutdown.

Shut down the tactical repeater as follows:

- a. Set the power supply POWER switch to OFF.
- b. Ensure that the POWER LED is not illuminated.

Section II. PREPARATION FOR RESHIPMENT

3-4 PREPARING UNIT FOR RESHIPMENT.

Prepare the tactical repeater for reshipment as follows:

- a. Disconnect all external accessories, antennas, and cables.
- b. Remove the receiver-transmitters prior to shipment.
- c. Remove batteries (if installed).

3-5 PACKING.

Pack the tactical repeater in the recommended packages illustrated in Figure 2-1. Use original packing materials if available.

3-6 HANDLING AND STORAGE.

Place electronic assemblies in individual containers. This will prevent damage during handling and storage. If a common container is used, use suitable barrier material between electronic assemblies. Sufficient packing must be used to prevent shifting of electronic assemblies within the container. Package the equipment in accordance with MIL-STD-2073-1A/2B. Marking for reshipment and storage shall be in accordance with MIL-STD-129J.

CAUTION

Never apply pressure sensitive tape directly to connectors. This could damage connector pins.

3-6.1 Protective Measures for Electrical Connectors.

Protect all unmated connectors that are exposed to physical or environmental damage by covering with supplied protective caps.

3-6.2 Preparation for Shipment and Storage.

Before preparing the equipment for shipment or storage, ensure that the receiver-transmitters, batteries, and any other accessories have been removed from the tactical repeater.

CAUTION

Package all electrostatic discharge (ESD) sensitive assemblies in ESD bags before shipping or storing.

For shipment to another facility or long-term storage, package the unit as shown in Figure 2-1. Regardless of the electronic assembly design, fit all protruding parts with packing spacers, wrap the complete assembly with plastic or place in a plastic air-lock bag. Wrap with a protective cellulose, foam, or similar material. Wrap assemblies that contain electrostatic discharge sensitive (ESDS) parts in static protective materials.

3-6.3 Handling.

Following are general handling instructions which should be followed when handling the equipment.

WARNING

Before performing removal/replacement procedures, make sure power is removed from the unit. Failure to do so could result in personal injury or damage to the equipment.

CAUTION

Rough handling may cause unnecessary damage to electronic assemblies.

CAUTION

CAUTION

Electronic assemblies containing solid-state devices are susceptible to damage from static electrical discharges. Wear protective clothing and grounded wrist straps. Forcing any tilted or cocked electronic assembly into position may result in bent or broken pins.

Be very careful when removing or inserting an assembly into the equipment. If it is a plug-in CCA, be sure the guide pins are properly aligned before pressing the assembly in place. If the CCA tilts while being inserted, do not continue to press into position; straighten it, then apply even pressure to avoid tilting.

CAUTION

When repairing an electronic assembly, be careful that the tool employed does not inadvertently press against leads, pins, or other parts that are easily bent.

CAUTION

Because of the miniaturization of parts for electronic assembly construction, the leads, connectors, and pins have been stiffened to make them more rugged. As a result, such parts are brittle and will break easily if bent too often or pulled on too hard. When handling an assembly that has been removed from its chassis, be careful not to press against the leads and pins. When removing an assembly, be sure to pull it straight out from the equipment. Do not cock, twist, pry, or carelessly jerk an electronic assembly to remove it from the mounting or connector.

CAUTION

ELECTROSTATIC DISCHARGE

The tactical repeater contains components that are susceptible to damage by static electrical charges. Disassembly of the tactical repeater should only be done at a properly grounded work station.

CHAPTER 4.0 OPERATION

Section I. CONTROLS AND INDICATORS

4-1 INTRODUCTION.

This section describes and illustrates indicators, controls, switches, and connectors of the tactical repeater.

4-2 CONTROLS AND INDICATORS.

The following paragraphs describe and illustrate all operational controls and indicators of the tactical repeater.

4-2.1 Indicators, Controls and Switches.

All indicators, controls, and switches for the tactical repeater are illustrated in Figure 4-1 and described in Table 4-1.

4-2.2 Power Supply Switches and Connectors.

The tactical repeater power switches and top connectors are located on the power supply assembly. The power switches are illustrated in Figure 4-2 and described in Table 4-2.

4-2.3 Connectors.

External side connectors for the power supply are illustrated in Figure 4-3 and described in Table 4-3. External connectors for the repeater unit are illustrated in Figure 4-4 and described in Table 4-4.

4-2.4 Diplexer Controls.

All diplexer controls for the tactical repeater are illustrated in Figure 4-5 and described in Table 4-5.

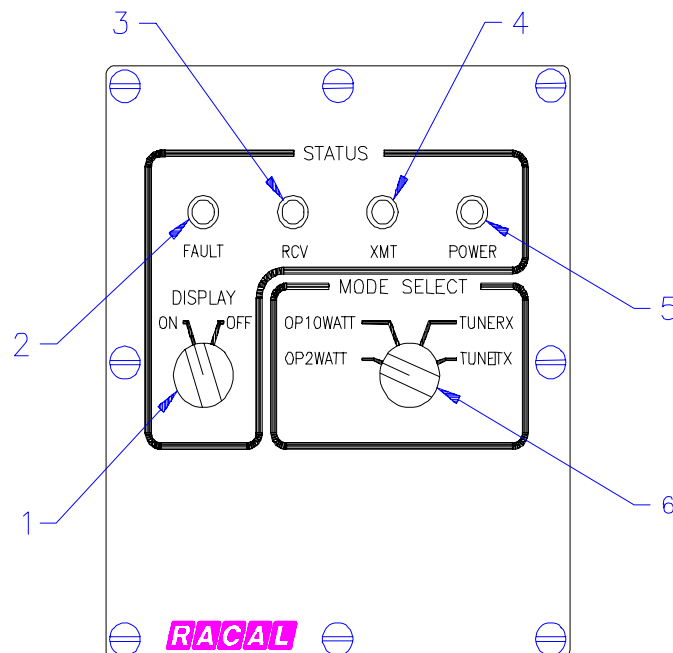


Figure 4-1. Location of Tactical Repeater Indicators, Controls and Switches

Table 4-1. Description of Indicators, Controls and Switches

Fig & Index Number	Control/Switch	Function
4-1-1	STATUS: DISPLAY Switch (two-position rotary switch)	Controls whether the front panel indicators are operational (ON position) or not operational (OFF position) (The DISPLAY switch should be kept in OFF position to conserve battery life following initial power-up and function check.)
4-1-2	FAULT LED (red)	When illuminated, indicates RF power amplifier temperature is excessive (greater than 90°C).
4-1-3	RCV (Receive) LED (amber)	When illuminated in the OP2WATT and OP10WATT modes, indicates reception of a transmission. Illuminates also in the TUNERX mode to indicate keying of the RCV receiver-transmitter.
4-1-4	XMT (Transmit) LED (amber)	When illuminated in OP2WATT and OP10WATT modes, indicates retransmission of a reception. Illuminates also in the TUNETX mode to indicate keying of the XMT receiver-transmitter.
4-1-5	POWER LED (green)	When illuminated, indicates power is applied to the tactical repeater.
4-1-6	MODE SELECT Switch (four-position rotary switch)	Allows selection of the tactical repeater operating mode as follows: OP2WATT - Selects normal tactical repeater operation at an output power level of 2 watts. OP10WATT - Selects normal tactical repeater operation at an output power level of 10 watts. TUNERX - Allows the receive mode of the diplexer to be tuned. TUNETX - Allows the transmit mode of the diplexer to be tuned.

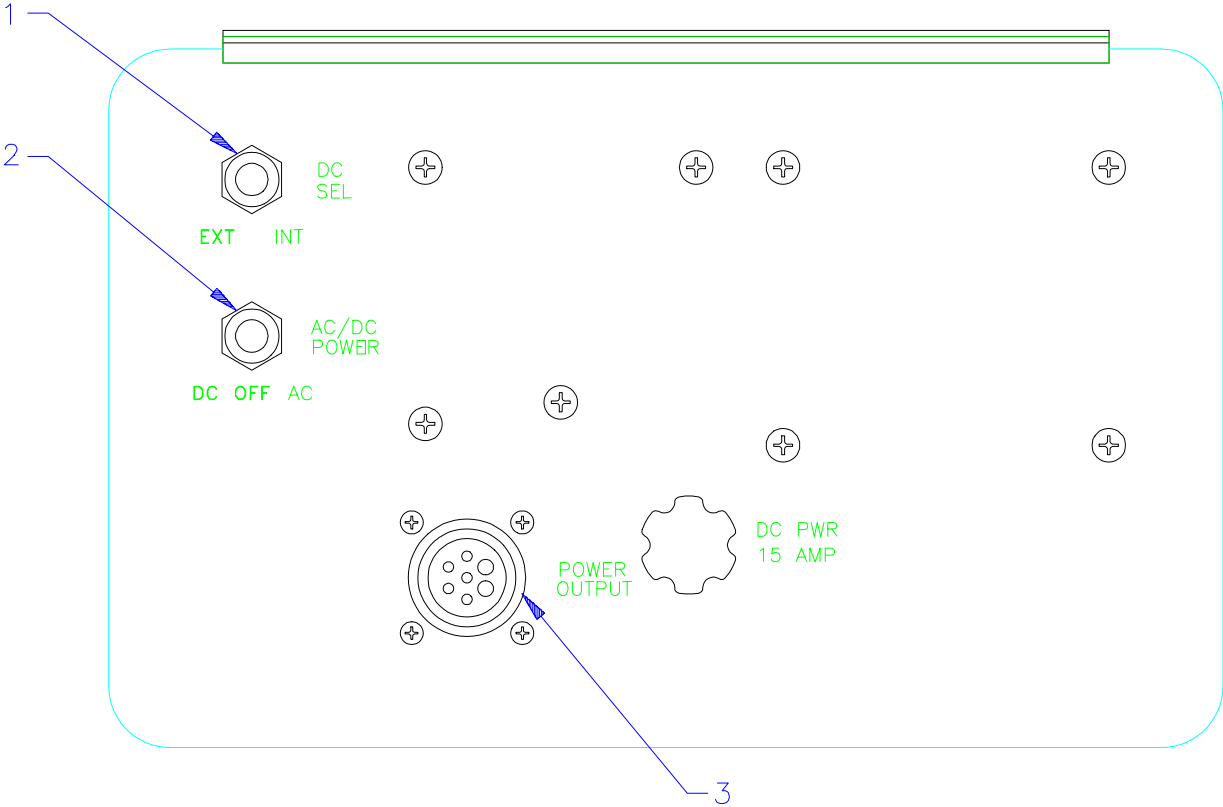


Figure 4-2. Location of Power Supply Switches (Power Supply Top View)

Table 4-2. Description of Power Supply Switches

Fig & Index Number	Switch	Function
4-2-1	DC SEL (INT/EXT) Select switch (two-position toggle switch)	Allows selecting either the internal battery power source or an external DC source when the AC/DC POWER switch is in the DC position.
4-2-2	AC/DC POWER (DC/OFF/AC) switch (three-position toggle switch)	Allows the operator to turn the tactical repeater on and off, and select either an AC or DC power source.
4-2-3	POWER OUTPUT	Connector for power output cable to Tactical Repeater Unit

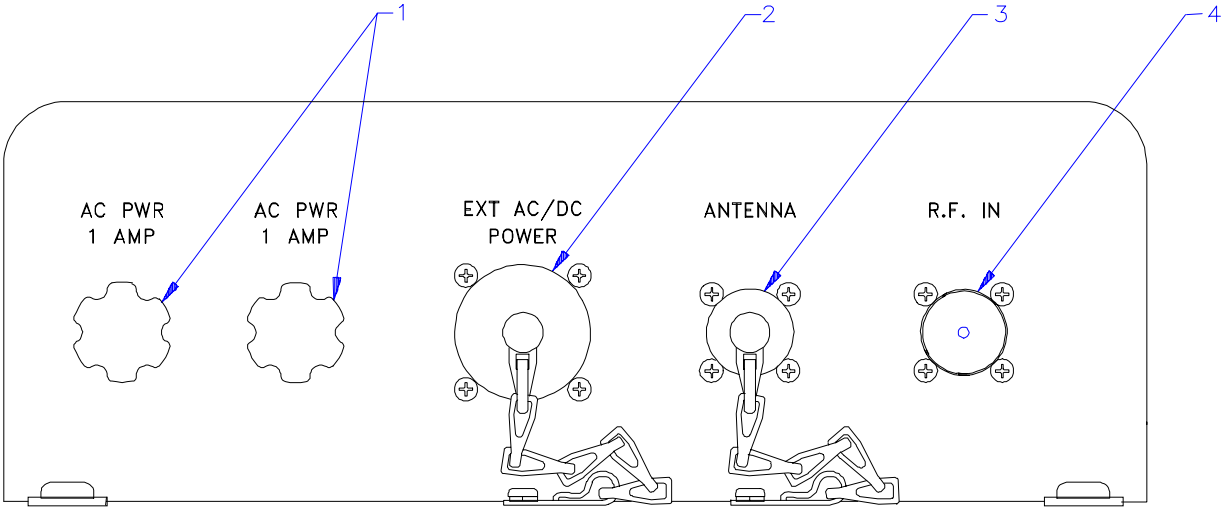


Figure 4-3. Location of Power Supply Connectors (Power Supply Side View)

Table 4-3. Description of Power Supply Connectors

Fig & Index Number	Connectors	Function
4-3-1	AC Power Fuse 1 Amp	In-line fuse for AC input power
4-3-2	External Power Input Connector	External power supply input.
4-3-3	Antenna Out	Coaxial cable to antenna.
4-3-4	RF In	Coaxial cable to diplexer.

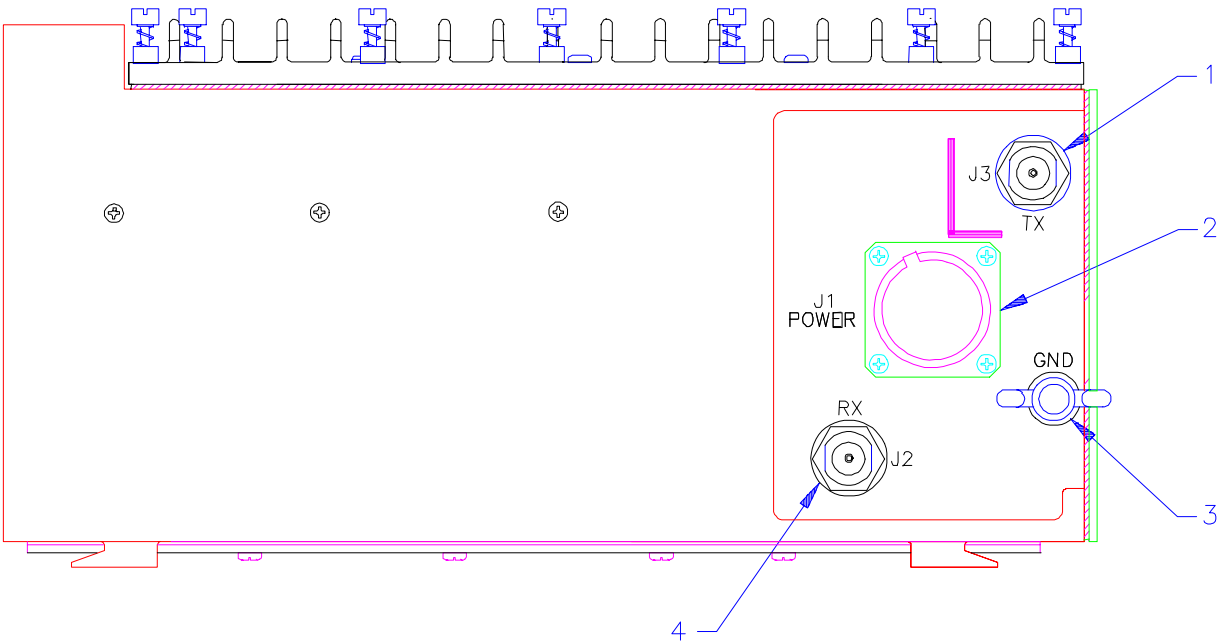


Figure 4-4. Location of Tactical Repeater Unit Connectors

Table 4-4. Description of Repeater Unit Connectors

Fig & Index Number	Connectors	Function
4-4-1	TX (Transmit) Connector J3	Input from diplexer transmit connector to repeater.
4-4-2	POWER Connector J1	Connects repeater to repeater power supply unit.
4-4-3	GND (Ground) Stud	Provides chassis ground point; connects repeater unit to frame system ground.
4-4-4	RX (Receive) Connector J2	Input from diplexer receive connector to repeater.

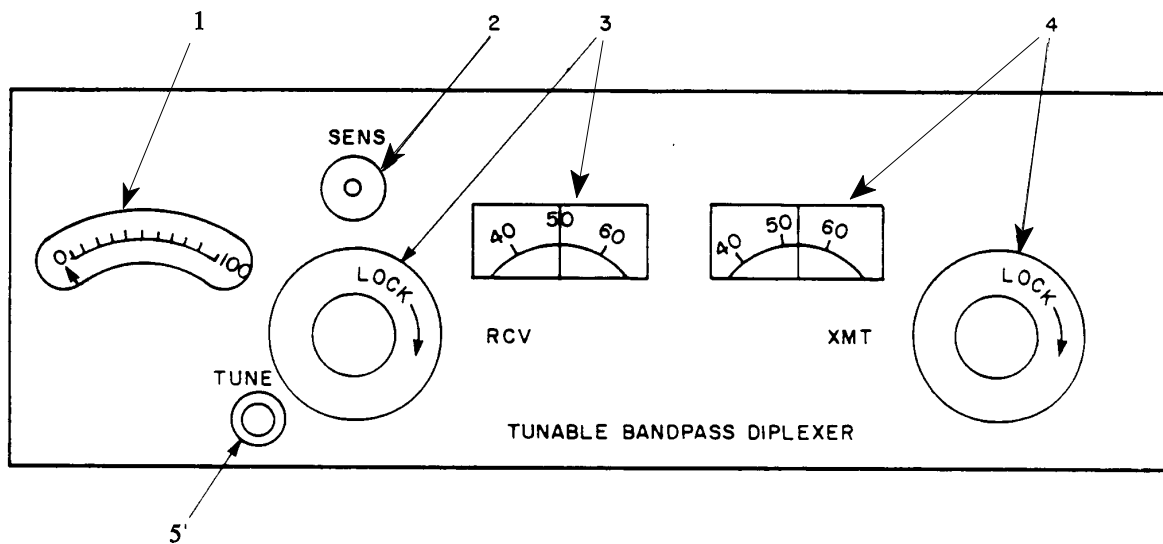


Figure 4-5. Location of Tactical Repeater Diplexer Controls

Table 4-5. Description of Diplexer Controls

Fig & Index Number	Indicator/Control/Switch	Function
4-5-1	Tuning Meter	Measures relative strength of transmit or receive signals
4-5-2	SENS Control	The SENS control is only active when the TUNE switch is held depressed. The SENS control adjusts the meter sensitivity for tuning purposes. Maximum clockwise position allows the meter to respond to low RF inputs.
4-5-3	RCV (Receive) Control	The RCV control adjusts the bandpass frequencies of the diplexer for the RCV receiver-transmitter. Movement of the RCV control corresponds to the RCV frequency dial movement.
4-5-4	XMT (Transmit) Control	The XMT control adjusts the bandpass frequencies of the diplexer for the XMT receiver-transmitter. Movement of the XMT control corresponds to the XMT frequency dial movement.
4-5-5	TUNE Switch	When held depressed, allows diplexer meter to respond to RF input from the RCV or XMT receiver-transmitter. The TUNE switch is used in conjunction with the SENS control to accomplish tuning. The TUNE switch has a locking mechanism to prevent inadvertent moving.

Section II. OPERATING INSTRUCTIONS

NOTE

Be aware that while performing the initial power-up and diplexer tuning procedures, the tactical repeater will radiate RF energy which can cause frequency interference. Do not perform this procedure before the [frequency use authorization is obtained and in effect](#).

4-3 INITIAL POWER-UP AND DIPLEXER TUNING PROCEDURES.

Perform the following procedure to power-up the tactical repeater and tune the diplexer.

- a. Ensure that the RF cables are properly connected to TX connector J3 (4, Figure 4-4) and RX connector J2 (1, Figure 4-4). Ensure that the proper antenna and diplexer are installed.
- b. Ensure that the tactical repeater has been installed as described in Chapter 2. Place the AC/DC POWER switch (1, Figure 4-2) in the DC or AC position, as applicable, and the DISPLAY switch (1, Figure 4-1) in ON position. Verify that the green POWER LED (5, Figure 4-1) is illuminated.
- c. Using the channel select switch on the transmit receiver-transmitter, select as the transmit channel the same channel that is being used by the remote receiving receiver-transmitter.
- d. Using the channel select switch on the receive receiver-transmitter, select as the receive channel the same channel that is being used by the remote transmitting receiver-transmitter. Ensure that the receive receiver-transmitter is programmed in a simplex configuration for all channels to allow for diplexer tuning.
- e. Set the diplexer SENS control (2, Figure 4-5) fully clockwise.
- f. Release locking ring on diplexer RCV tuning dial (3, Figure 4-5). If the receive frequency is known, adjust the RCV tuning dial (3, Figure 4-5) to the appropriate receive channel frequency.
- g. Release the locking ring on the XMT tuning dial. If the transmit channel frequency is known, adjust the XMT tuning dial (4, Figure 4-5) to the approximate transmit channel frequency.
- h. Place the tactical repeater MODE SELECT switch (6, Figure 4-1) in the TUNERX position.
- i. Adjust the RCV tuning dial (3) with the red TUNE button (1) depressed until a peak meter indication is noticed. If the meter produces 100% deflection turn SENS control (2) counterclockwise until adjustment of the RCV control yields a peak response less than 100% deflection. Tighten RCV locking ring.
- j. Set the SENS control fully clockwise.
- k. Place the tactical repeater MODE SELECT switch (6, Figure 4-1) in the TUNETX position.
- l. Adjust the diplexer XMT tuning dial (4, Figure 4-5) with the red TUNE button (5) depressed until a peak meter indication is noticed. If the meter produces 100% deflection turn the SENS control counterclockwise until adjustment of the XMT control yields a peak response less than 100% deflection. Tighten the locking ring on the XMT tuning dial.
- m. Set the MODE SELECT switch to OP2WATT or OP10WATT as desired.
- n. Place the DISPLAY switch (1, Figure 4-1) to the OFF position to conserve battery life.

After the above procedures have been successfully completed, the tactical repeater is in an operational mode and can begin to relay receiver-transmitter traffic.

4-4 RECEIVING AND RETRANSMITTING MESSAGE.

Whenever the tactical repeater is turned on, it is capable of receiving messages and transmitting them (relaying them) back out. Receive and retransmit messages as follows:

- a. Perform the initial power-up and diplexer tuning procedure of paragraph 4-3 to turn on the tactical repeater and prepare it for operation.
- b. Set the MODE SELECT switch (6, Figure 4-1) to OP2WATT or OP10WATT.
- c. Ensure the receive receiver-transmitter is programmed with the proper type squelch settings to receive the desired modulation format (carrier squelch or CTCSS tones).
- d. When a carrier with the proper modulation format is received by the repeater, the XMT LED (4, Figure 4-1) illuminates to verify proper transmit operation.
- e. If the receive receiver-transmitter is programmed for carrier squelch and the repeater receives a carrier without CTCSS tones, with CTCSS tones or with encryption, the RCV LED (3, Figure 4-1) illuminates to verify proper operation. If the receive receiver-transmitter is programmed for a CTCSS receive tone, the RCV LED (3, Figure 4-1) illuminates only when a carrier with the correct CTCSS tone is received. If the receive receiver-transmitter is programmed for a CTCSS receive tone and the repeater receives an encrypted format, the RCV LED (3, Figure 4-1) will not illuminate; however, the encrypted message is retransmitted and can be verified by observing that only the XMT LED (4, Figure 4-1) is illuminated.

4-5 COVERT OPERATIONS.

By placing the DISPLAY switch (1, Figure 4-1) in the OFF position, all LEDs on the front panel of the tactical repeater are disabled to allow light discipline in blackout conditions. Turning off the LEDs also helps to conserve battery power.

4-6 RECEIVER-TRANSMITTERS.

For operating procedures for the receiver-transmitter, refer to TO 31R2-2PRC139-1. Disregard operating procedures for secure mode.

4-7 EQUIPMENT SHUTDOWN.

Shut down the tactical repeater as follows:

- a. Place the AC/DC POWER switch (1, Figure 4-2) in the OFF position.
- b. Verify that the receiver-transmitter is off by confirming that the POWER LED is not illuminated when the DISPLAY switch (1, Figure 4-1) is in the ON position.

Section III. EMERGENCY OPERATION

4-8 EMERGENCY POWER.

The tactical repeater can be powered directly from a battery installed in a vehicle for external power. Use the DC power supply cable assembly (SS-4500109-501) with the positive cable lug connected to the positive battery terminal and the negative cable lug grounded to the vehicle frame.

4-9 ELECTROMAGNETIC PULSE PROTECTION.

Electromagnetic Pulse (EMP) is a pulse of broad bandwidth, high amplitude radio frequency electromagnetic energy produced by the radiation from a nuclear burst.

4-9.1 EMP Susceptibility.

EMP can deliver a power density to a radio receiver a billion times greater than the power necessary for reception. The voltage and current surges resulting from EMP can overload most modern solid state electronic devices.

4-9.2 EMP Protective Measures.

All equipment not absolutely required in primary systems should remain disconnected and stored within a sealed shelter or other shielded enclosure for protection from EMP. To prevent or reduce "coupling" with the energy from EMP, wires and cables (to include output coaxial types) should be shielded and properly grounded. Lengths of cables should be kept as short as possible. Excess lengths of cable in use should never be left wound on a cable reel but should be pulled out in a straight line to avoid having loops in the cables. When cables are not needed, they should not be connected to the equipment. Burying cables a foot or more will reduce their exposure to EMP fields. Antennas and their connecting cables should be disconnected from radiosets when not in use. Narrow bandwidth antennas requiring high power for operation reduce the EMP coupling effect.

4-10 NUCLEAR, BIOLOGICAL, AND CHEMICAL (NBC) CONTAMINATION.

The Scope Shield equipment has a Chemical Agent Resistant Coating (CARC) finish that reduces the susceptibility to NBC contamination. However, in the event the equipment does become contaminated, great care must be exercised in performing decontamination before the equipment can be returned to use. The power supply must be disconnected to prevent personnel injury and equipment damage. The best way to decontaminate communications equipment is with hot air, although metal surfaces exposed to blister agents and V-agents may be decontaminated with DS2.

WARNING

DS2 is highly corrosive and must be used with extreme care to avoid rendering equipment inoperable.

CHAPTER 5.0 THEORY OF OPERATION

Section I. FUNCTIONAL SYSTEM(S) OPERATION

5-1 GENERAL.

This section describes the theory of operation of the tactical repeater. From both technical and operational standpoints, the tactical repeater is designed to be a component of a communications system. It must function in conjunction with other receiver-transmitters to perform receiver-transmitter communication. However, it does not depend on other receiver-transmitters for its proper functioning or performance.

The tactical repeater operates in the 30-88, 136-174, and 403-470 MHz frequency bands, retransmitting analog frequency modulation (FM), or 12 kbps or 16 kbps Continuously Variable Slope Delta Modulation (CVSD) digitized voice. The transmitter output consists of a single channel frequency-modulated carrier. The transmitter power output as measured at the antenna port is selectable at 2 or 10 watts. The tactical repeater is COMSEC transparent and does not have internal COMSEC components. It can pass both encrypted and unencrypted traffic. The tactical repeater provides extension of the communication range for base stations and receiver-transmitters by providing a receive/retransmit capability without the need to decrypt/encrypt the transmission. It operates as a self-contained/stand-alone unit in an unprotected environment.

5-2 FUNCTIONAL SYSTEM(S) OPERATION.

(See Figure 5-1.) Paragraphs 5-2.1 through 5-2.10 provide a limited system description of the tactical repeater. The functional diagrams (Figure 5-1) show the interrelationship between the main circuits of the tactical repeater.

5-2.1 +15V DC-DC Converter Circuit Card Assembly (CCA) (A1).

The +15V DC-DC converter CCA (A1) provides regulated +15 VDC to the repeater control CCA (A3) and both hand-held receiver-transmitters. The DC-DC converter operates from a 10-32 VDC input.

5-2.2 Repeater Control Circuit Card Assembly (CCA) (A3).

The repeater control CCA (A3) combines the signal control and the audio interface between the receive receiver-transmitter and the transmit receiver-transmitter. The assembly provides reclocking of data when data format is received by the receive receiver-transmitter. It also automatically identifies whether a 12 kbps or 16 kbps signal is received. This CCA contains timing circuits to control the push-to-talk (PTT) line of the transmit receiver-transmitter. Timing circuitry is included to reduce the possibility of missing the initial data bits. Received audio is routed to the microphone line of the transmit receiver-transmitter and the SQ/CTS, signal present line of the receive receiver-transmitter is converted to the PTT line of the transmit receiver-transmitter. The repeater control CCA passes both clear and encrypted signals.

5-2.3 Parent Board Circuit Card Assembly (CCA) (A4).

This card provides the interconnection between the other circuit card assemblies and provides power to the receiver-transmitters.

5-2.4 Control Panel (A5).

The control panel (A5) contains all operator controls and indicators.

5-2.5 RF Power Amplifier Assembly (A6).

The RF power amplifier (A6) amplifies the output of the receiver-transmitter inserted in the XMT sleeve to 2 or 10 watts, measured at the output of the diplexer, as determined by the setting of the MODE SELECT switch.

The amplifier will function in the entire frequency range of 30-470 MHz, with transceiver operation only in the 30-88, 136-174, and 403-470 MHz frequency bands.

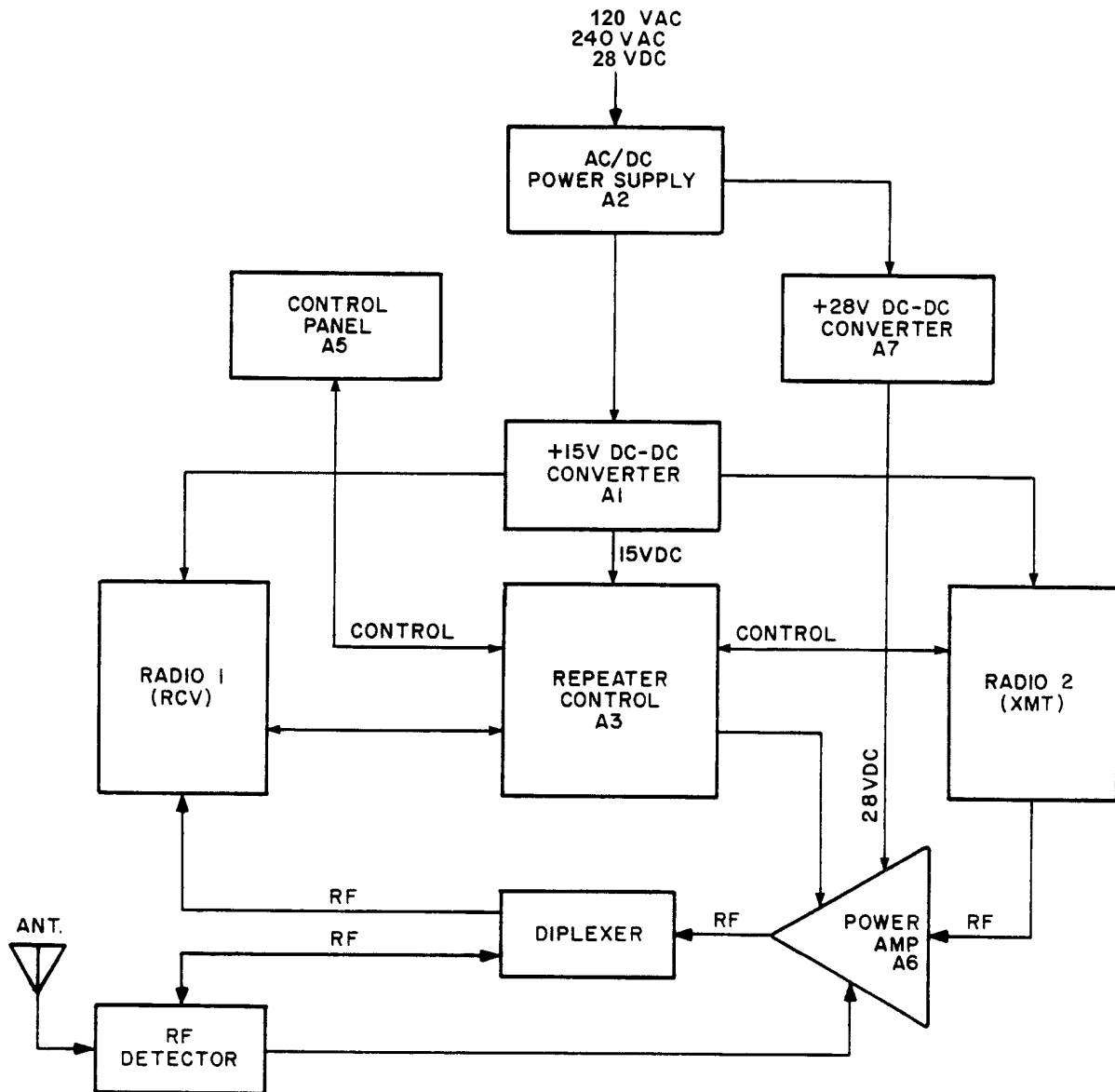


Figure 5-1. Tactical Repeater System, Functional Block Diagram

5-2.6 +28V DC-DC Converter Circuit Card Assembly (CCA) (A7).

The +28V DC-DC converter (A7) provides regulated +28 VDC to the RF power amplifier (A6). The power converter operates from a 10-32 VDC input.

5-2.7 Receiver-Transmitter.

Two receiver-transmitters are used in the tactical repeater. One is designated for receive operation and the other is designated for transmit only. The type of receiver-transmitter used in the tactical repeater is a transceiver (combination transmitter and receiver) capable of operating in the 30-88, 136-174, or 403-470 MHz frequency bands. The receiver-transmitter used within the tactical repeater (RT-1695/TRC-199) differs from the standard receiver-transmitter (RT-1696/U/(C)) only in that the repeater version does not have encryption/decryption capability. The tactical repeater is COMSEC transparent and does not need to decrypt encrypted traffic prior to relaying it back out over the transmit frequency.

Refer to TO 31R2-2PRC139-1 for additional information on the receiver-transmitter. TO 31R2-2PRC139-1 covers both the RT-1695/TRC-199 and RT-1696/U(C) receiver-transmitters. Both receiver-transmitters are identical except the RT-1696/U(C) is fitted with an INDICTOR COMSEC encryption/decryption integrated circuit and is designated a Controlled Cryptographic Item (CCI). The RT-1696/U(C) receiver-transmitter, which is part of the AN/PRC-139(C) and AN/GRC-238, shall not be used in the tactical repeater. The RT-1695/TRC-199 and RT-1696/U(C) receiver-transmitters have different notches on the chassis base (part of the battery connector) which mate with matching notches in the different units in which they are installed. This prevents inadvertent installation of the RT-1696/U(C) in the tactical repeater.

5-2.8 Antenna System.

The antenna for the tactical repeater provides simultaneous transmit and receive capability. The antenna provides transmit and receive frequency coverage over one of each of the bands of operation. Three antennas cover all of the frequency bands of operation, 30-88, 136-174, and 403-470 MHz.

The antenna provides an average gain in each band as indicated in Table 5-1.

Table 5-1. Antenna System Frequency Band Vs Gain

Frequency Band	Gain
30-88 MHz	-7 dBi to +2 dBi (-9.14 dB to -.14 dB relative to a 1/2 wavelength dipole - {dBD})
136-174 MHz	+2.5 dBi or greater (>+.36 dBD)
403-470 MHz	+2.5 dBi or greater (>+.36 dBD)

5-2.9 Diplexer.

The diplexer provides a method of using a receiver and a transmitter on a common antenna. The diplexer, when properly tuned, provides a transmitter to receiver isolation of 70 dB at any frequency spacing of 4 MHz or 3% of the operating frequency, whichever is greater. The diplexer has an insertion loss of less than 2.25 dB between the transmit port and the antenna, and less than 3.0 dB between the receive port and the antenna. The diplexer is capable of handling 60 watts of RF power in the transmit path and provides protection at the receive port to limit receive signals to a maximum level of +33 dBm (for dBi, dBm, see Glossary).

5-2.10 AC/DC Power Supply (A2).

The AC/DC power supply enables the tactical repeater system to operate from the following power sources:

- External 115V 50/60 Hz AC
- External 230V 50/60 Hz AC
- External 10V to 32V DC
- Four self-contained replaceable batteries; type BA5590/U Lithium

All external power sources are accessed through a common connector. A unique cable is provided to accommodate each source. Two toggle switches operate as described in Table 4-2.

The power supply also incorporates an RF peak detector which produces a DC voltage that is proportional to the transmitted RF power. The detector is used with the repeater unit as part of the RF output power automatic level control (ALC).

Section II. FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS

5-3 REPEATER CONTROL CIRCUIT CARD ASSEMBLY (CCA) (A3).

(See Figure 5-2.) As shown in Figure 5-2, the repeater control CCA (A3) consists of the following major functions:

- a. Input limiter
- b. Clear path
- c. Data path
- d. 12 kbps detector
- e. 16 kbps detector
- f. Clocks and controls

5-4 15 WATT POWER AMPLIFIER ASSEMBLY (A6).

(See Figure 5-3.) As shown in Figure 5-3, the 15 watt power amplifier assembly (A6) consists of the following major functions:

- a. RF signal path and AMPKEY control
- b. Automatic level control
- c. Manual level control
- d. RF detector
- e. Thermal protection
- f. Current limiting
- g. EEPROM
- h. Voltage regulators

Section III. FUNCTIONAL OPERATION OF MECHANICAL ASSEMBLIES

Not Applicable.

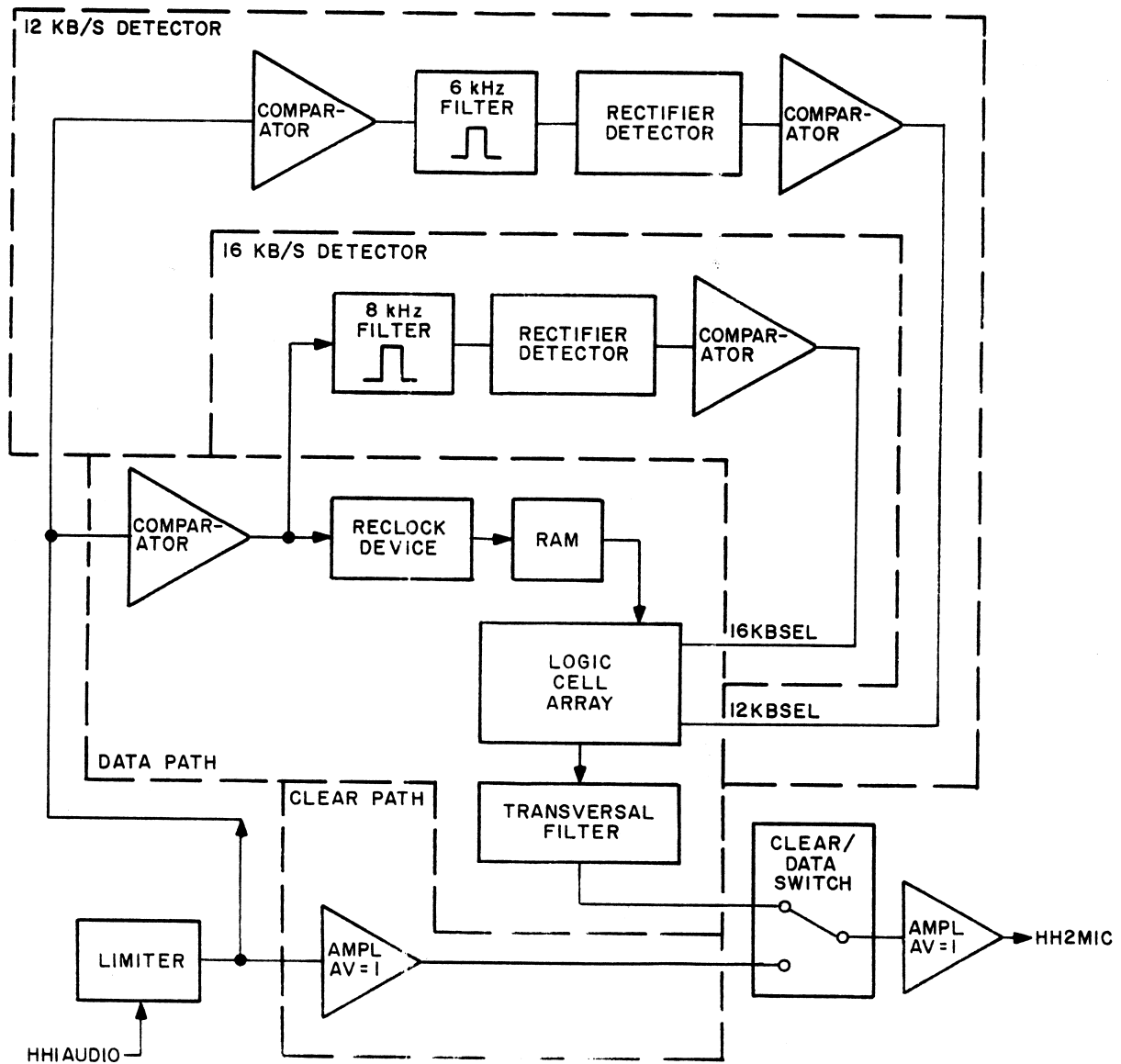


Figure 5-2. Repeater Control CCA (A3), Functional Block Diagram

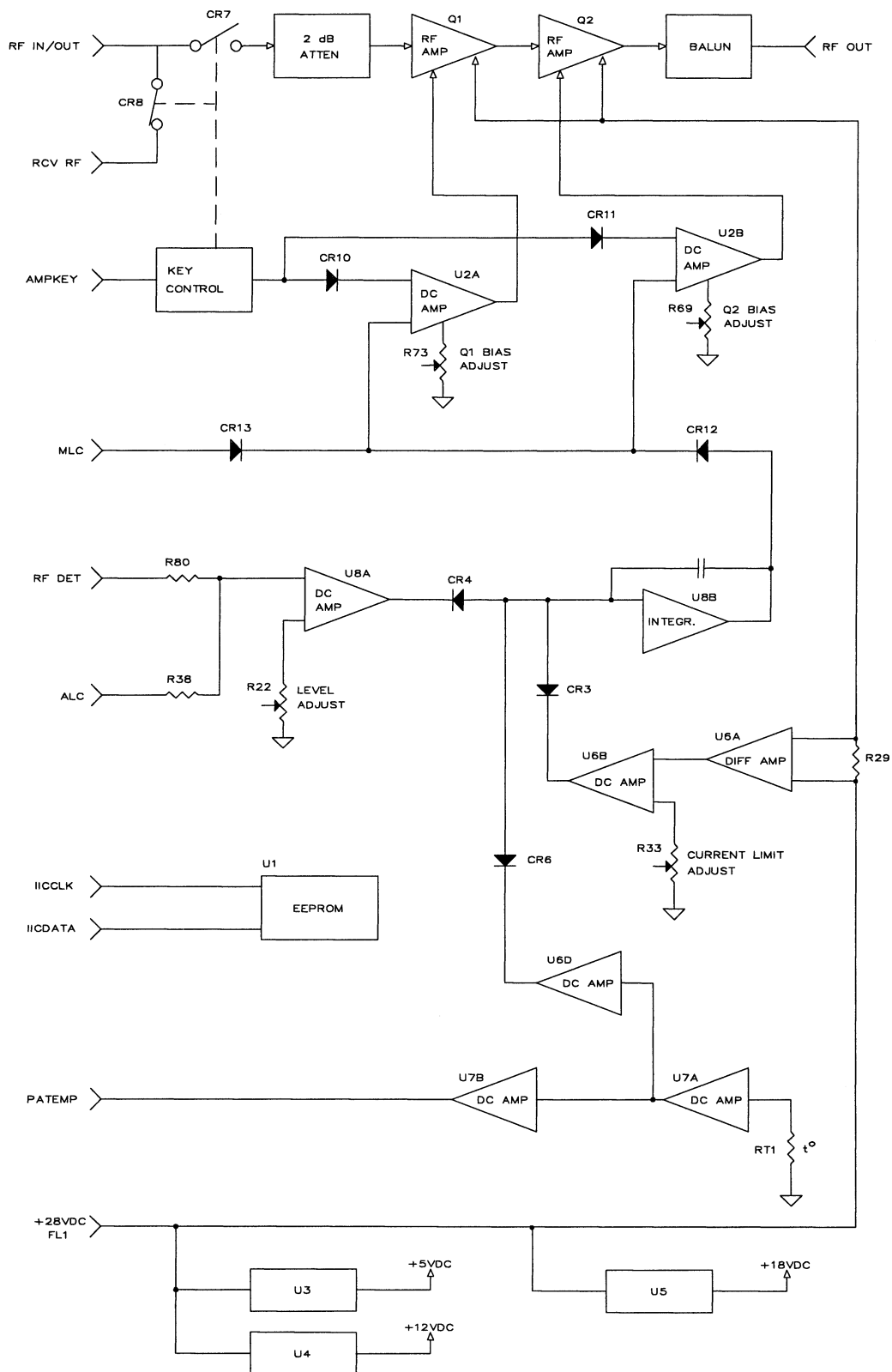


Figure 5-3. 15 Watt Power Amplifier Assembly (A6), Functional Block Diagram

CHAPTER 6.0 MAINTENANCE

6-1 GENERAL.

This chapter provides organizational maintenance instructions for the tactical repeater. This includes operational checkout, inspection and preventive maintenance, troubleshooting, and removal/replacement procedures.

6-2 OPERATIONAL CHECKOUT.

Perform the procedures in paragraphs 6-2.1 through 6-2.5 to check the tactical repeater for normal operation. These checks should be performed when equipment is used for the first time, when the equipment has been damaged, or if the equipment has not been used for an extended period of time.

NOTE

Prior to conducting the operational checkout, the receiver-transmitter used in the test must be properly programmed and configured. Refer to TO 31R2-2PRC139-1.

6-2.1 Power-up Verification.

Check the tactical repeater power-up operation as follows:

- a. Ensure that the antenna has been installed as indicated in paragraph 2-10.1. Refer to the tactical repeater interconnection diagram (FO-1).
- b. Set the tactical repeater switches and controls as indicated in Table 6-1.

Table 6-1. Initial Switch and Control Settings for Power-Up Verification

Switch/Control	Position
AC/DC POWER switch (1, Figure 4-2)	OFF
INT/EXT switch (2, Figure 4-2)	INT or EXT, as applicable
MODE SELECT switch (6, Figure 4-1)	OP2WATT
DISPLAY switch (1, Figure 4-1)	ON
RCV Channel	1
XMT Channel	2

- c. Set the AC/DC POWER switch to AC or DC, as applicable. Verify that the green POWER LED (5, Figure 4-1) is the only LED illuminated.

6-2.2 Display Off Control.

Check the functionality of the DISPLAY switch as follows:

- a. Place the DISPLAY switch (1, Figure 4-1) in the OFF position. Verify that the green POWER LED (5, Figure 4-1) goes off.
- b. Set the DISPLAY switch to ON. Verify that the green POWER LED illuminates.

6-2.3 Receive Tune Mode Verification.

Verify functionality of receive mode as follows:

- a. Set the tactical repeater switches and controls as indicated in Table 6-2.

Table 6-2. Initial Switch and Control Settings for Receive Tune Mode Verification

Switch/Control	Position
AC/DC POWER switch (1, Figure 4-2)	AC or DC, as applicable
INT/EXT switch (2, Figure 4-2)	INT or EXT, as applicable
MODE SELECT switch (6, Figure 4-1)	TUNERX
RCV Channel	1
XMT Channel	2

- b. Verify that the only LEDs illuminated on the tactical repeater front panel are POWER and RCV.
- c. Verify that the green LED on the receive receiver-transmitter is illuminated and that the green LED on the XMT receiver-transmitter is not illuminated.

6-2.4 Transmit Tune Mode Verification.

Verify functionality of transmit mode as follows:

NOTE

Be aware that while performing the initial power-up and diplexer tuning procedures, the tactical repeater will radiate RF energy which can cause frequency interference. Do not perform this procedure before the frequency use authorization is effective.

- a. Set the tactical repeater switches and controls as indicated in Table 6-3.

Table 6-3. Initial Switch and Control Settings for Transmit Tune Mode Verification

Switch/Control	Position
AC/DC POWER switch (1, Figure 4-2)	AC or DC, as applicable
INT/EXT switch (2, Figure 4-2)	INT or EXT, as applicable
MODE SELECT switch (6, Figure 4-1)	TUNETX
RCV Channel	1
XMT Channel	2

- b. Verify that the only LEDs illuminated on the tactical repeater front panel are POWER and XMT.
- c. Verify the green LED on the XMT receiver-transmitter is illuminated and the green LED on the RCV receiver-transmitter is not illuminated.

6-2.5 Fault LED.

The red FAULT LED (2, Figure 4-1) on the tactical front panel is illuminated when the power amplifier temperature is excessive. A thermistor in the power amplifier will trigger the fault indication when the internal temperature of the power amplifier reaches 90°C (194°F). Power amplifier current draw is decreased slowly until the temperature decreases to approximately 80°C (176°F).

6-3 SERVICING.

6-3.1 Servicing Intervals.

Table 6-4 provides recommended service intervals.

Table 6-4. Recommended Service Intervals

Task	Recommended Interval			
	D	W	M	Q
Visual inspection (see paragraph 6-3.2)	X			
Preventive maintenance:				
Inspection (see paragraph 6-3.3.1)		X		
Cleaning (see paragraph 6-3.3.2)			X	

D = Daily

W = Weekly

M = Monthly

Q = Quarterly

6-3.2 Inspection.

Many potential or existing faults can be detected by making a visual inspection of the equipment. For this reason, a visual inspection should be made on a routine basis or whenever the tactical repeater is inoperative.

NOTE

If any discrepancies are observed, return the unit to higher level maintenance.

At a minimum, the following items should be inspected by the operator.

- a. Inspect the equipment covers and front panel for condition of finish and panel markings.
- b. Inspect for dents, punctures, and warped areas.
- c. Inspect external surfaces for loose or missing screws or washers.
- d. Inspect the receptacles and connectors for condition of pins, contacts, and mounting.
- e. Inspect the antenna for signs of physical damage.
- f. Inspect the knobs and switches for mechanical integrity.
- g. Inspect LEDs for dust accumulation.

6-3.3 Preventive Maintenance.

The tactical repeater requires very little routine maintenance other than inspection and cleaning. The operator shall perform the following procedures at the intervals recommended in Table 6-4.

6-3.3.1 Inspection.

Inspect the tactical repeater as follows:

- a. Inspect the equipment covers and front panel for condition of finish and panel markings.
- b. Inspect the unit for dents, punctures, or worn areas.
- c. Inspect external surfaces for loose or missing screws or washers.
- d. Inspect the receptacles and connectors for condition of pins, contacts, and mounting.
- e. Inspect antenna for signs of physical damage.
- f. Inspect the knobs and switches for mechanical integrity.
- g. Inspect LEDs for dust accumulation.

6-3.3.2 Cleaning.

Cleaning should be performed to remove accumulated dust and other contaminants. Clean the tactical repeater as follows:

- a. Dust the switches and LEDs with a soft-bristled brush.
- b. Remove dirt clinging to the tactical repeater with a clean, lint-free cloth dampened with a mild detergent and water solution. Avoid using abrasive cleaners, as they will scratch the unit's surface.
- c. Wipe internal sleeve contacts (connection to the receiver-transmitter) with a clean, dry, lint-free cloth.
- d. Clean the receiver-transmitter side connector contacts by rubbing with a soft pencil eraser.

6-4 TROUBLESHOOTING.

Tables 6-5 and 6-6 describe possible system malfunctions, their probable cause(s), and the corrective action required by the operator or the repair specialist to return the equipment to an operational state. All solutions which suggest replacement of an item assume that the item used to make the replacement is a known good item.

Table 6-5 contains the symptoms of possible system malfunctions which can be acted on by the operator. Only those procedures contained within Table 6-5 are authorized to be performed by the operator. Table 6-6 identifies additional possible system malfunctions that can be corrected by the repair specialist. Troubleshooting procedures contained in Tables 6-5 and 6-6 are authorized to be performed by the repair specialist. Prior to performing any repair actions, the repair specialist should perform the following inspections:

- a. The repair specialist should inspect those items which were inspected by the operator.
- b. Inspect the internal components for signs of deterioration, discoloration, or charring. Check for melted insulation and damage, cracked or broken components.
- c. Inspect the printed circuit boards for damaged tracks, loose connections, corrosion, or other sign of deterioration.
- d. Inspect the printed circuit (PC) connectors, interface connectors, and chassis wiring for excessive wear, looseness, misalignment, corrosion, or other signs of deterioration.

Before referring to Tables 6-5 or 6-6, ensure that the DISPLAY switch (1, Figure 4-1) is in the ON position, that the receiver-transmitters are correctly programmed and controls are properly set, and that a matching configuration of receiver-transmitters, antennas, and diplexers is installed. Refer to Table 6-7 for cross-reference to removal/replacement procedures.

Table 6-5. Organizational Maintenance Guide - Operator

Symptom	Possible Cause	Remedy
a. Repeater does not have any lamps illuminated, and b. Repeater does not receive or transmit with power and modulation	Failed power source	Restore prime power
	Failed batteries	Replace batteries/check power source
	Failed RCV receiver-transmitter	Replace RCV receiver-transmitter
	Failed XMT receiver-transmitter	Replace XMT receiver-transmitter
	Failed power cable(s)	Replace power cable(s)
	Failed power supply	Replace power supply
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair
Fault LED is illuminated	RF power amplifier temperature is excessive (greater than 90°C).	Turn off tactical repeater until temperature decreases. If LED again illuminates, return tactical repeater to the repair specialist.
a. Repeater does not have any lamps illuminated, and b. Repeater receives and transmits with power and modulation	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair
Repeater does not receive at any frequency and no front panel indicators are illuminated	Bad or no programming	Check receiver-transmitters for proper frequency information and correct if required
	Failed diplexer	Replace diplexer
	Failed lightning protection device	Replace lightning protection device
	Failed antenna	Replace antenna
	Failed antenna cable	Replace antenna cable
	Failed RCV receiver transmitter	Replace receiver-transmitter
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair
Repeater constantly transmits without valid signal	Bad or no programming	Check receiver-transmitters for proper frequency information and correct if required
	Failed RCV receiver-transmitter	Replace RCV receiver-transmitter
	Failed XMT receiver-transmitter	Replace XMT receiver-transmitter
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair

Table 6-5. Organizational Maintenance Guide - Operator - CONT

Symptom	Possible Cause	Remedy
Repeater transmits with correct power but with no modulation	Failed RCV receiver-transmitter	Replace RCV receiver-transmitter
	Failed XMT receiver-transmitter	Replace XMT receiver-transmitter
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair
a. Repeater receives but with degraded sensitivity, and	Mismatched antenna	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
b. Repeater transmits with correct power and modulation	Failed antenna	Replace antenna
	Failed RCV receiver-transmitter	Replace RCV receiver-transmitter
	Mismatched diplexer	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed diplexer	Replace diplexer
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair
a. Repeater transmits with no power and modulation or degraded power and modulation, and	Improper diplexer adjustment	Perform diplexer adjustment
b. Repeater receive characteristics meets specified levels	Mismatched diplexer	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed diplexer	Replace diplexer
	Bad or no programming	Check receiver-transmitters for proper frequency information - correct if required
	Mismatched antenna	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed antenna	Replace antenna
	Failed antenna cable	Replace antenna cable
	Failed XMT receiver-transmitter	Replace XMT receiver-transmitter
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair

Table 6-5. Organizational Maintenance Guide - Operator - CONT

Symptom	Possible Cause	Remedy
Repeater receive characteristics are frequency sensitive; some but not all frequencies meet specified levels	Mismatched receiver-transmitter	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed RCV receiver-transmitter	Replace RCV receiver-transmitter
	Mismatched diplexer	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed diplexer	Replace diplexer
	Mismatched antenna	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed antenna	Replace antenna
	Failed antenna cable	Replace antenna cable
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair
Repeater transmit characteristics are frequency sensitive; some but not all frequencies meet specified levels	Mismatched receiver-transmitter	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed RCV receiver-transmitter	Replace RCV receiver-transmitter
	Mismatched diplexer	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed diplexer	Replace diplexer
	Mismatched antenna	Ensure same configuration of receiver-transmitter, diplexer, and antenna are installed
	Failed antenna	Replace antenna
	Failed antenna cable	Replace antenna cable
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair

Table 6-5. Organizational Maintenance Guide - Operator - CONT

Symptom	Possible Cause	Remedy
Repeater has some indicators working but not all	Failed RCV receiver-transmitter	Replace RCV receiver-transmitter
	Failed XMT receiver-transmitter	Replace XMT receiver-transmitter
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair
Repeater will not pass either clear or encrypted data or passes distorted audio signal	Failed RCV receiver-transmitter	Replace RCV receiver-transmitter
	Failed XMT receiver-transmitter	Replace XMT receiver-transmitter
	Failed tactical repeater assembly	Return the tactical repeater assembly to the repair specialist for repair
Unable to power radio through side connector	Failed receiver-transmitter	Return the receiver-transmitter to the repair specialist for repair

Table 6-6. Organizational Maintenance Guide - Repair Specialist

Symptom	Possible Cause	Remedy
a. Repeater does not have any lamps illuminated, and	Failed repeater control CCA	Remove and replace repeater control CCA
b. Repeater does not receive or transmit with power and modulation	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
a. Repeater does not have any lamps illuminated, and	Failed control panel assembly	Remove and replace control panel assembly
b. Repeater receives and transmits with power and modulation	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
Repeater does not receive at any frequency and no front panel indicators are illuminated	Failed repeater control CCA	Remove and replace repeater control CCA
	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
Fault LED is illuminated	RF power amplifier temperature is excessive (greater than 90°C)	Remove and replace 15W RF power amplifier assembly
	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
Repeater constantly transmits without valid signal	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
Repeater transmits with correct power but with no modulation	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
a. Repeater receives but with degraded sensitivity, and	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
b. Repeater transmits with correct power and modulation		
a. Repeater transmits with no power and modulation or degraded power and modulation, and	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
b. Repeater receive characteristics meets specified levels		
Repeater receive characteristics are frequency sensitive; some but not all frequencies meet specified levels	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair

Table 6-6. Organizational Maintenance Guide - Repair Specialist - CONT

Symptom	Possible Cause	Remedy
Repeater transmit characteristics are frequency sensitive; some but not all frequencies meet specified levels	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
Repeater has some indicators working but not all	Fault cannot be isolated/repared at the repair specialist level	Return the tactical repeater assembly to depot for repair
Repeater will not pass either clear or encrypted data or passes distorted audio signal	Failed repeater control CCA	Remove and replace repeater control CCA
Unable to power radio through side connector	Failed receiver-transmitter	Return the receiver-transmitter to the repair specialist for repair

Table 6-7. Cross-Reference to Removal/Replacement Procedures

Items to be Removed/Replaced	Applicable Procedure (Paragraph Number)
Antenna	6-5.1.2
Antenna cable	6-5.1.1
Control panel assembly (A5)	6-5.2.2
Diplexer	6-5.1.6
Power cable	6-5.1.4
Power supply	6-5.1.5
Receiver-transmitter	6-5.1.3
Repeater control CCA (A3)	6-5.2.1
Tactical repeater assembly	6-5.1.7
15 watt power amplifier assembly (A6)	6-5.2.3

6-5 REMOVAL/REPLACEMENT PROCEDURES.

6-5.1 Removal/Replacement Procedures - Operator.

The first step for any removal/replacement procedure is to power down the equipment. Then remove all accessories (antenna, handset, etc.). Removal/replacement procedures which are authorized to be performed by the operator are given in paragraphs 6-5.1.1 through 6-5.1.7.

WARNING

Before performing removal/replacement procedures, make sure power is removed from the unit by disconnecting from power source. Failure to do so could result in personal injury or equipment damage.

6-5.1.1 Antenna Cable Removal/Replacement.

Remove/replace antenna cable as follows:

- a. Disconnect the antenna cable from the connector at the rear of the diplexer by turning counterclockwise.
- b. Disconnect the antenna cable from the connector at the base of the antenna mast by grasping the connector on the antenna cable and turning counterclockwise.
- c. Replace with a new antenna cable onto the connectors on the antenna mast and repair of the diplexer.

6-5.1.2 Antenna Removal/Replacement.

Remove/replace the antenna as follows:

WARNING

This equipment is capable of generating RF power sufficient to cause RF burns. During transmit, care should be taken to eliminate the possibility of touching exposed RF output points such as the center conductors of coaxial cables or antenna feedpoints.

- a. Disconnect the antenna from the antenna connector mounted on the mast by removal of mounting hardware.
- b. Disconnect the coaxial cable.
- c. Replace the antenna with a known good antenna.

6-5.1.3 Receiver-Transmitter Removal/Replacement.

Remove/replace the receive (RCV) or transmit (XMT) receiver-transmitter as follows:

- a. Remove the receiver-transmitter from the tactical repeater by turning the locking knob on the front panel counterclockwise one-quarter turn.
- b. Pull the receiver-transmitter from the sleeve.
- c. Reinsert a known good receiver-transmitter into the tactical repeater.

6-5.1.4 Power Cable Removal/Replacement.

Remove/replace power cable as follows:

- a. Disconnect the power cable from the connector at the rear of the tactical repeater by grasping the base of the power cable connector and turning counterclockwise.
- b. Disconnect the power cable from the connector on the power supply by grasping the base of the power cable connector and turning counterclockwise.
- c. Replace a new power cable onto the connectors on the tactical repeater and power supply.

6-5.1.5 Power Supply Removal/Replacement.

Remove/replace the power supply as follows:

- a. To remove the power supply (21, Figure 7-1), first disconnect the two power cables (32 and 46, 47, or 48) by grasping the base of each power cable and turning counter-clockwise. Remove the coaxial cable (23) leading from the diplexer (33). Then remove the screws (22) holding the power supply mounting plate to the weldment frame (5). Remove the power supply.

- b. Replace the power supply with a known good power supply.

6-5.1.6 Diplexer Removal/Replacement.

Remove/replace the diplexer as follows:

- a. To remove the diplexer (33, Figure 7-1), disconnect the coaxial cables (23, 30, and 31) leading to the tactical repeater assembly (1) and the power supply (21).
- b. Remove the screws (35), washers (36), and shock mounts (24, 27, and 28) under the diplexer holding the diplexer to the weldment frame (5).
- c. Replace the diplexer with a known good diplexer for the same frequency band.

6-5.1.7 Tactical Repeater Assembly Removal/Replacement.

Remove/replace the tactical repeater assembly as follows:

- a. Disconnect the coaxial cables (30, 31, Figure 7-1), the power cable (32), and the grounding strap (34).
- b. Loosen the two screws (35) that secure the front clamp (37) to the weldment frame (5).
- c. Raise the front of the tactical repeater assembly (1) and slide it forward.
- d. Replace the tactical repeater with a known good tactical repeater.

6-5.2 Removal/Replacement Procedures - Repair Specialist.

These procedures are authorized to be performed by the repair specialist only, and are in addition to those performed by the operator. These procedures are not applicable to the operator. Prior to performing any remove/replace procedures, ensure the equipment is powered down and disconnected from the power source and remove all accessories (antenna cable). To replace components into the tactical repeater, reverse the removal procedures, unless otherwise directed.

WARNING

Before performing removal/replacement procedures, make sure power is removed from the unit. Failure to do so could result in personal injury or equipment damage.

CAUTION

ELECTROSTATIC DISCHARGE

The tactical repeater contains components that are susceptible to damage by static electrical charges. Disassembly of the tactical repeater should only be done at a properly grounded work station.

6-5.2.1 Repeater Control Circuit Card Assembly (CCA) (A3) (SS-4100805-501) Removal/Replacement.

Remove/replace the repeater control CCA (A3) as follows:

- a. Remove the bottom cover (20, Figure 7-2) by removing the 16 screws (7) that secure the bottom cover to the chassis.
- b. Unplug the repeater control CCA (A3) (21) by pulling evenly on the card connectors at each end of the card.
- c. Replace with a known good repeater control CCA (A3) by pushing evenly on the card extractors at each end of the card. Ensure that the card edges are aligned with the tracks on the sides of the chassis.

- d. Reattach the bottom cover by tightening the 16 screws that secure the bottom cover to the chassis. When refitting the bottom cover to the chassis, check the EMI gasket (19) to ensure that it is undamaged and properly seated.

6-5.2.2 Control Panel Assembly (A5) (SS-4100071-501) Removal/Replacement.

Remove/replace the control panel assembly (A5) as follows:

- a. Loosen the eight captive screws securing the control panel (29, Figure 7-2) to the tactical repeater chassis (13).
- b. Pull the control panel straight out from the chassis.
- c. To replace, reverse the above steps.

6-5.2.3 15 Watt Power Amplifier Assembly (A6) (SS-4100853-501) Removal/Replacement.

Remove/replace the power amplifier (PA) assembly (A6) as follows:

- a. Place the tactical repeater upside down.
- b. Remove the tactical repeater bottom cover.
- c. Pull clamps away from connector on J4 on parent board. Remove connector of amplifier control cable assembly (A6W1).
- d. Turn tactical repeater over; leave cover off.
- e. The 15 watt power amplifier assembly (A6) (1, Figure 7-2) is mounted on the top of the tactical repeater chassis (13). First, unscrew the 20 captive screws (2, Figure 7-3) that hold the PA assembly to the chassis. Grasp one of the heatsink fins and slightly raise the front end of the PA assembly.
- f. Unscrew the cable connector holding the coaxial RF cable assembly (W4) (39, Figure 7-2) to the RF Out (J4) connection on the PA assembly and pull the cable from the connection.
- g. Detach the amplifier power cable assembly (W9)(14) from the DC In (FL1) and GND (E9) connections on the PA assembly.
- h. Remove the screws (42) holding the two cable clamps (44) onto the PA assembly and remove the cable clamps and cables W9 and W4.
- i. Raise the PA assembly to allow access to the back of the PA assembly. Disconnect the amplifier control cable assembly (A6W1)(3) from J4 on the parent board.
- j. Unscrew the cable connector holding the coaxial RF cable assembly (W3)(12) to the RF IN/OUT (J2) connection on the assembly and pull cable W3 from the connection.
- k. Lift the 15 watt power amplifier assembly from the tactical repeater unit.
- l. To replace, reverse the above steps.

6-13/(6-14 blank)

CHAPTER 7.0 ILLUSTRATED PARTS BREAKDOWN

Section I. INTRODUCTION

7-1 GENERAL.

The Illustrated Parts Breakdown (IPB) lists, illustrates, and describes the parts used in the Scope Shield Radio Set AN/TRC-199. The items are manufactured by Racal Communications, Inc., Rockville, Maryland.

7-2 MAINTENANCE PARTS LIST.

The Maintenance Parts List (MPL), (Section II), consists of the complete systems divided into main groups. The main groups are broken down into assemblies, subassemblies, and details. The next higher assembly (NHA) is indicated for each separately illustrated item. Each assembly and subassembly listed is followed immediately by its component parts. In general, the assemblies and parts installed at the time the end item was manufactured are listed and identified in the manual. When an assembly/part (including vendor items) different from the original was installed during manufacture of the later items, series, or blocks, all assemblies and parts are listed (and "Usable on" coded). However, when the original assembly or part does not have continued application, only the preferred assembly or part is listed. When an assembly/part installed during modification, and the original does not have continued application, only the preferred item is listed. Interchangeable and substitute assemblies and parts, subsequently authorized by the Government, are not listed in this manual. When a standard size part can be replaced with an oversize/undersize part, the latter parts, showing sizes, are also listed.

- a. Figure and Index Number Column. This column lists the figure and index number of each part illustrated in the related figure. The index numbers are in numerical sequence and indicate order of disassembly except where the order does not apply. Index numbers identify each part number shown in the related figure. Assemblies which have detail parts indexed are not indexed unless; the assembly is illustrated completely assembled on the same illustration; or it is identified as an assembly by bracketing or circling of components. When a group of parts (bolt, washer, nut) is used at a specific location for attachment purposes, one index number assigned is sufficient. The index number appears on the same line as the first part composing the group.
- b. Part Number Column. This column lists the contractor's part number (drawing number), including dash numbers, assigned to each part. Vendor part numbers are listed when parts are identical to the contractor used part. Those parts which have Government Standards numbers assigned have the Government Standards number listed. Parts altered or selected for special fit, tolerance, etc., from vendor, commercial, or Government Standards part number of the altered or selected part follow the part description in the Description column. Item(s) of supply part number(s) and Contractor and Government Entity (CAGE) that is stocked, stored, and issued by the Government as identified by the Government during the initial provisioning process shall be identified by an (*) sign preceding the part number one space to the left. Government Furnished Equipment (GFE) and Contractor Furnished Equipment (CFE), covered by separate manuals are listed and identified by a number sign (#) inserted flush right following the part number. Decalcomania, metal-cals, and vinyl film markings are considered as parts. The part number for each marking will be followed by an asterisk (*) symbol inserted flush right. Requisition the marking in accordance with the requirements of AFR 6-1.
- c. CAGE Column. This column contains a five-digit code number following the part number denoting the procuring vendor. The source of vendor code numbers is the CAGE for Manufacturer Cataloging Handbook H4-1, H4-2, and H4-3. When a CAGE for the appropriate manufacturer or Government agency is not published in the current issues of the H4 handbook, the word "none" will appear in this column.
- d. Description Column. This column contains the description of all items appearing on the MPL. The indentation headed "1" through "7" consists of the approved item name, as found in the Federal Item Identification Guide for Supply Catalog Handbook H6-1, or is in accordance with the contractor's drawing title. The description contains modifiers necessary to identify the particular item. Additional information following the item description may include the following: a list of alternate part numbers to give stock ordering information; exceptions to the Usable On Code for the item; and references to

preceding and subsequent figures concerning assemblies and subassemblies. This data is considered an integral part of the item description assuring the correctness of repair maintenance procedures.

- e. Attaching Parts. Items used to attach parts or assemblies to each other are listed immediately after the part. The attaching parts have the same indentation code as the parts attached. The code (AP) appears on the same line with and immediately following the attaching part item.
- f. Units Per Assembly. This column contains the number of units required per assembly and/or subassembly. If more than one assembly is required, the total number of assemblies is listed. When an assembly or subassembly is listed more than once, the total number of units per assembly or subassembly appears the first time and REF for subsequent listings.
- g. Usable on Code Column. This column shows the Usable On Codes for systems, assemblies, and parts indicating specific usability by part number. Usable on code explanations are located at the bottom of the applicable page. The codes A, B, C, etc., when shown within a group, relate the part back to the same coded part within the next higher assembly. When this column is left blank, an assembly or part is common to all part number variation of the next higher assembly.
- h. Source, Maintenance, and Recoverability (SMR) Codes. This manual contains Joint Military Services Uniform SMR codes. Detailed coding criteria may be obtained from T.O. 00-25-195.

7-3 NUMERICAL INDEX.

The Numerical Index (Chapter 7, Section III) is compiled in accordance with the numerical part number filing system described in paragraph a.

- a. Part Number Column. This column contains all the part numbers that appear in the Maintenance Parts List and part numbers that have been assigned to detail parts assembled into the end article. The order of procedure establishing the precedence in which the part numbers are listed is explained below. The order of precedence in the first position of each part number is letters A through Z, numerals 0 through 9.

NOTE

Alphabetical O's are considered as numerical zeroes in all positions in each part number.

The order of precedence in the second and succeeding positions in each part number is as follows:

- (1) Space (blank column).
- (2) Diagonal (/).
- (3) Period (.)
- (4) Dash (-).
- (5) Letters A through Z.
- (6) Numerals 0 through 9.

The following is a sample of part numbers arranged in alphabetical-numerical sequence used in the Numerical Index.

AN931-4-13	B2	16.W2
A2460	S/1	16W060
A317	1140	32P010.1
A32	121873	32P0101
B12	128	39A45

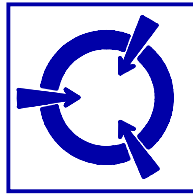
- b. Figure and Index Number Column. For each part number, the figure or figure and index number refers to the MPL where the parts relationship is shown. When an assembly or part has not been assigned an index number, the figure and index number of the preceding part in the MPL is used with the letter "F" before the figure, such as F7-7. The letter "F" denotes "follows".

7-4 REFERENCE DESIGNATION INDEX.

The Reference Designation Index (Chapter 7, Section IV) is listed by figure as it appears in the MPL, then in alphabetical-numerical order, the reference designations used in schematic diagrams and instruction books. Opposite the reference designation is listed the figure index number as shown in the MPL.

7-5 ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES.

- a. This technical order contains parts and assemblies sensitive to damage by ESD. T.O. 00-25-234 should be consulted for specific information on how damage can occur to electronic parts, assemblies, and equipment by ESD and the control measures to be taken to protect against such damage.
- b. Illustrations contained within this manual which depict ESD parts are further identified by the use of the following symbol affixed in the lower right-hand corner of each applicable illustration.



- c. The MPL contained within this manual with ESD sensitive parts are identified by the following symbol (ESD). These symbols are placed in the extreme right of the description column for the item as ESD sensitive.

7-6 CAGE CODE SUMMARY.

<u>CAGE Code</u>	<u>Manufacturer</u>
1BZ19	C and S Antennas, Inc.
05972	Locktite Corp.
07700	Technical Wire Products, Inc.
13074	Multi-Flex Seals, Inc.
23386	Racal Communications, Inc.
23657	Shakespeare Co.
27264	Molex Inc.
52437	Bretford MFG, Inc.
73734	Federal Screw Products, Inc.
74790	National Lightening Corp.
76385	Minor Rubber Co., Inc.
79557	Vetex Computer Cable and Products
81349	Military Specifications
82820	Reif M. M. and Co., Inc.
85480	Brady W. H. Co.
86928	Seastorm MFG Co., Inc.
96906	Military Standards

HOW TO USE THE ILLUSTRATED PARTS BREAKDOWN

IF PART NUMBER IS NOT KNOWN DO THIS

FD-2000-10-10-0

TABLE OF CONTENTS

Section	Page	Section	Page
APPENDICES			
Appendix A General	1	Page 10. Regional map and index map	10
Appendix B	2	Page 11. Regional map and index map	11
Appendix C	3	Page 12. Regional map and index map	12
Appendix D	4	Page 13. Regional map and index map	13
Appendix E	5	Page 14. Regional map and index map	14
Appendix F	6	Page 15. Regional map and index map	15
Appendix G	7	Page 16. Regional map and index map	16
Appendix H	8	Page 17. Regional map and index map	17
Appendix I	9	Page 18. Regional map and index map	18
Appendix J	10	Page 19. Regional map and index map	19
Appendix K	11	Page 20. Regional map and index map	20
Appendix L	12	Page 21. Regional map and index map	21
Appendix M	13	Page 22. Regional map and index map	22
Appendix N	14	Page 23. Regional map and index map	23
Appendix O	15	Page 24. Regional map and index map	24
Appendix P	16	Page 25. Regional map and index map	25
Appendix Q	17	Page 26. Regional map and index map	26
Appendix R	18	Page 27. Regional map and index map	27
Appendix S	19	Page 28. Regional map and index map	28
Appendix T	20	Page 29. Regional map and index map	29
Appendix U	21	Page 30. Regional map and index map	30
Appendix V	22	Page 31. Regional map and index map	31
Appendix W	23	Page 32. Regional map and index map	32
Appendix X	24	Page 33. Regional map and index map	33
Appendix Y	25	Page 34. Regional map and index map	34
Appendix Z	26	Page 35. Regional map and index map	35
Appendix AA	27	Page 36. Regional map and index map	36
Appendix AB	28	Page 37. Regional map and index map	37
Appendix AC	29	Page 38. Regional map and index map	38
Appendix AD	30	Page 39. Regional map and index map	39
Appendix AE	31	Page 40. Regional map and index map	40
Appendix AF	32	Page 41. Regional map and index map	41
Appendix AG	33	Page 42. Regional map and index map	42
Appendix AH	34	Page 43. Regional map and index map	43
Appendix AI	35	Page 44. Regional map and index map	44
Appendix AJ	36	Page 45. Regional map and index map	45
Appendix AK	37	Page 46. Regional map and index map	46
Appendix AL	38	Page 47. Regional map and index map	47
Appendix AM	39	Page 48. Regional map and index map	48
Appendix AN	40	Page 49. Regional map and index map	49
Appendix AO	41	Page 50. Regional map and index map	50
Appendix AP	42	Page 51. Regional map and index map	51
Appendix AQ	43	Page 52. Regional map and index map	52
Appendix AR	44	Page 53. Regional map and index map	53
Appendix AS	45	Page 54. Regional map and index map	54
Appendix AT	46	Page 55. Regional map and index map	55
Appendix AU	47	Page 56. Regional map and index map	56
Appendix AV	48	Page 57. Regional map and index map	57
Appendix AW	49	Page 58. Regional map and index map	58
Appendix AX	50	Page 59. Regional map and index map	59
Appendix AY	51	Page 60. Regional map and index map	60
Appendix AZ	52	Page 61. Regional map and index map	61
Appendix BA	53	Page 62. Regional map and index map	62
Appendix BB	54	Page 63. Regional map and index map	63
Appendix BC	55	Page 64. Regional map and index map	64
Appendix BD	56	Page 65. Regional map and index map	65
Appendix BE	57	Page 66. Regional map and index map	66
Appendix BF	58	Page 67. Regional map and index map	67
Appendix BG	59	Page 68. Regional map and index map	68
Appendix BH	60	Page 69. Regional map and index map	69
Appendix BI	61	Page 70. Regional map and index map	70
Appendix BJ	62	Page 71. Regional map and index map	71
Appendix BK	63	Page 72. Regional map and index map	72
Appendix BL	64	Page 73. Regional map and index map	73
Appendix BM	65	Page 74. Regional map and index map	74
Appendix BN	66	Page 75. Regional map and index map	75
Appendix BO	67	Page 76. Regional map and index map	76
Appendix BP	68	Page 77. Regional map and index map	77
Appendix BQ	69	Page 78. Regional map and index map	78
Appendix BR	70	Page 79. Regional map and index map	79
Appendix BS	71	Page 80. Regional map and index map	80
Appendix BT	72	Page 81. Regional map and index map	81
Appendix BU	73	Page 82. Regional map and index map	82
Appendix BV	74	Page 83. Regional map and index map	83
Appendix BW	75	Page 84. Regional map and index map	84
Appendix BX	76	Page 85. Regional map and index map	85
Appendix BY	77	Page 86. Regional map and index map	86
Appendix BZ	78	Page 87. Regional map and index map	87
Appendix CA	79	Page 88. Regional map and index map	88
Appendix CB	80	Page 89. Regional map and index map	89
Appendix CC	81	Page 90. Regional map and index map	90
Appendix CD	82	Page 91. Regional map and index map	91
Appendix CE	83	Page 92. Regional map and index map	92
Appendix CF	84	Page 93. Regional map and index map	93
Appendix CG	85	Page 94. Regional map and index map	94
Appendix CH	86	Page 95. Regional map and index map	95
Appendix CI	87	Page 96. Regional map and index map	96
Appendix CJ	88	Page 97. Regional map and index map	97
Appendix CK	89	Page 98. Regional map and index map	98
Appendix CL	90	Page 99. Regional map and index map	99
Appendix CM	91	Page 100. Regional map and index map	100

Figure 14. Heat Sink Assy, Tennessee

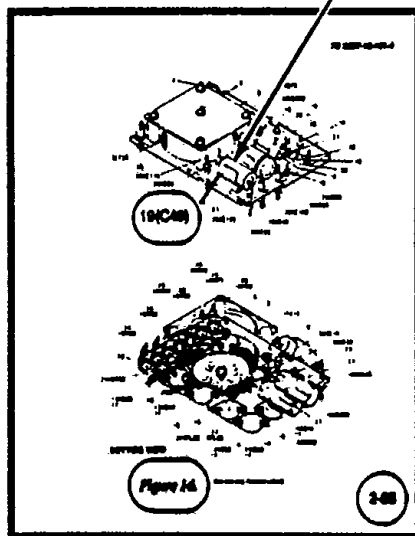
(A9A2) 2-45

44-38860-10

1. Determine the function and application of the desired part. Turn to the TABLE OF CONTENTS of the manual. From this list, select the illustration most likely to contain the desired part. Note figure number or page number.

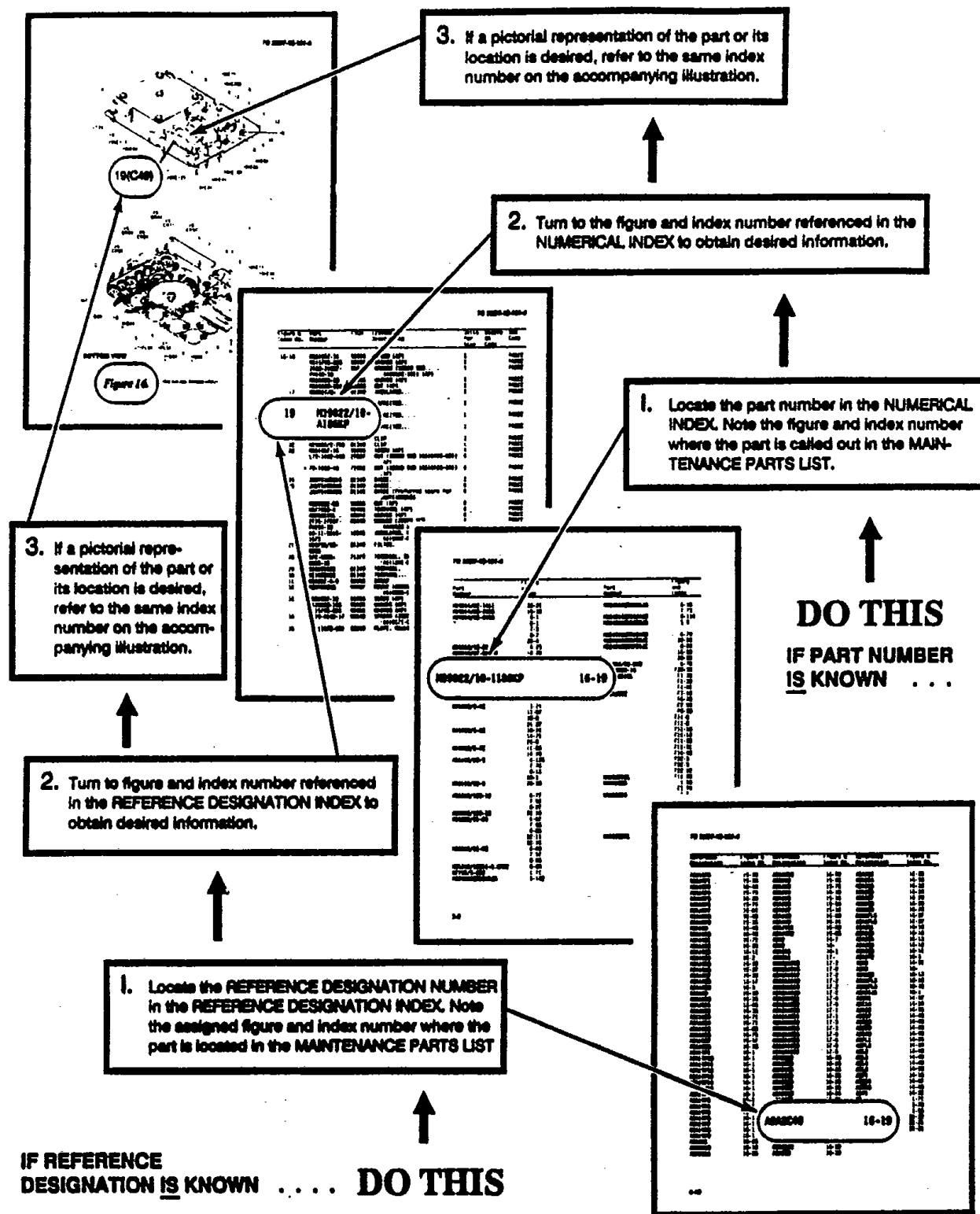
2. Refer to figure number or page number of the illustration selected from TABLE OF CONTENTS. Locate the desired part on the illustration. Note index number.

- 3. Refer to corresponding MAINTENANCE PARTS LIST.**
Locate the index number selected from the illustration
for part number, nomenclature, etc.



19 PAGES/10-11

HOW TO USE THE ILLUSTRATED PARTS BREAKDOWN



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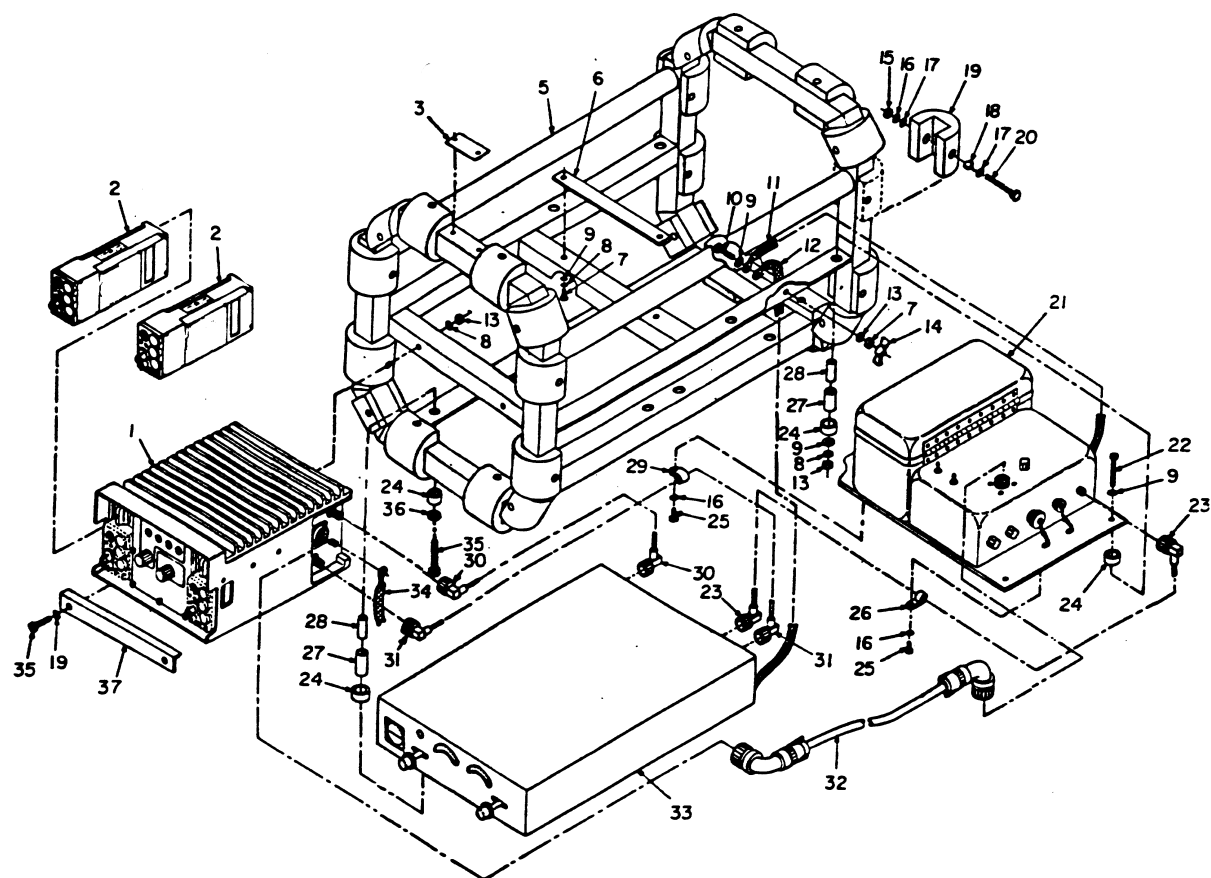


Figure 7-1. Radio Set AN/TRC-199 (Sheet 1 of 2)

Figure 7-1. Radio Set AN/TRC-199 (Sheet 2 of 2)

Section II. MAINTENANCE PARTS LISTS

Table 7-1. Radio Set AN/TRC-199

Figure & Index No.	Part Number	CAGE	Description	Units per Assy	Usable on Code	SMR Code
			1 2 3 4 5 6 7			
7-1	SS-4100793-502	23386	Radio Set AN/TRC-199 (refer to Figure 7-1 for breakdown)	0001		PEODDS
7-1-1 (A1)	SS-4100806-501	23386	⌘ Tactical Repeater Assembly (refer to Figure 7-2 for breakdown)	0001		PAOLDT
7-1-2 (A4,A5)	SS-4100807-512	23386	⌘ Receiver-Transmitter (refer to T.O 31R2-2PRC139-3 for breakdown)	0002		PAOLDT
7-1-2a	SS-4100859-501	23386	⌘⌘ Chassis/Electronic Equipment (refer to T.O. 31R2-2PRC139-3 for breakdown) (ESD)	0001		PADDDT
7-1-3	SS-2400523-1	23386	⌘ Plate, Identification.....	0001		XB
7-1-4	MS21318-20	96906	⌘ Screw, Drive (23386/76986) (SPEC CTRL DRW)	0002		PADZZN
7-1-5	SS-4400225-1	23386	⌘ Frame, Repeater, Weldment.....	0001		XB
7-1-6	SS-3100546-501	23386	⌘ Clamp, Rear	0001		XB
7-1-7	MS51957-79	96906	⌘ Screw, Machine (23386/77682) (SPEC CTRL DRW)	0001		PAOZZN
7-1-8	MS35338-139	96906	⌘ Washer, Lock..... (23386/75006) (SPEC CTRL DRW)	0012		PAOZZN
7-1-9	MS15795-810	96906	⌘ Washer, Flat..... (23386/75029) (SPEC CTRL DRW)	0014		PAOZZN
7-1-10	MS51957-84	96906	⌘ Screw, Machine (23386/77682) (SPEC CTRL DRW)	0001		PAOZZN
7-1-11 (W7)	SS-3500279-504	23386	⌘ Strap Assy, Ground	0001		MDF
7-1-12 (W6)	SS-3500279-503	23386	⌘ Strap Assy, Ground	0001		MDF
7-1-13	MS35690-410	96906	⌘ Screw, Machine (23386/75211) (SPEC CTRL DRW)	0001		PAOZZN
7-1-14	71206	73734	⌘ Nut, Wing (23386/SS-754007) (SPEC CTRL DRW)	0001		PAOZZN
7-1-15	MS35650-104	96906	⌘ Nut, Plain, Hexagon (23386/75210) (SPEC CTRL DRW)	0024		PAOZZN
7-1-16	MS35338-138	96906	⌘ Washer, Lock..... (23386/75005) (SPEC CTRL DRW)	0026		PAOZZN
7-1-17	MS15795-842	96906	⌘ Washer, Flat..... (23386/SS-75037) (SPEC CTRL DRW)	0048		PAOZZN
7-1-18	9286-A194-16AB	06540	⌘ Spacer (23386/SS-SP04-030) (SPEC CTRL DRW)	0048		PAOZZN
7-1-19	SS-3400353-1	23386	⌘ Bumpers TR, Frame	0024		XB

Figure & Index No.	Part Number	CAGE	Description	Units per Assy	Usable on Code	SMR Code
			1 2 3 4 5 6 7			
7-1-20	MS51958-73	96906	⌀ Screw, Machine (23386/SS-77776) (SPEC CTRL DRW)	0024		PAOZZN
7-1-21	SS-4100733-501	23386	⌀ Power Supply (refer to T.O 31R2-2TRC-199-3 for breakdown)	0001		PAOLDT
7-1-22	MS51957-87	96906	⌀ Screw, Machine (23386/SS-77691) (SPEC CTRL DRW)	0004		PAOZZN
7-1-23 (W3)	SS-3500292-502	23386	⌀ Cable Assy, Coaxial.....	0001		XB
7-1-24	SS-2400578-1	23386	⌀ Washer, Shock Mount	0016		XB
7-1-25	MS51958-61	96906	⌀ Screw, Machine (23386/77763) (SPEC CTRL DRW)	0002		PAOZZN
7-1-26	MS21919WDG7	96906	⌀ Clamp, Cable (23386/SS-81281) (SPEC CTRL DRW)	0002		PAOZZN
7-1-27	SS-2400577-1	23386	⌀ Bushing, Shock Mount	0008		XB
7-1-28	9268-A257-16	06540	⌀ Spacer..... (23386/SS-SP04-031) (SPEC CTRL DRW)	0008		PAOZZN
7-1-29	MS21919WDG4	96906	⌀ Cable, Clamp (23386/SS-81284) (SPEC CTRL DRW)	0002		PAOZZN
7-1-30 (W2)	SS-3500292-501	23386	⌀ Cable Assy, Coaxial.....	0001		XB
7-1-31 (W4)	SS-3500292-503	23386	⌀ Cable Assy, RF Coaxial.....	0001		XB
7-1-32 (W1)	SS-4500110-501	23386	⌀ Cable Assembly, TR-PS Power.....	0001		PAOZZN
7-1-33 (A3)	SS-1600322-501	23386	⌀ Diplexer Assembly 30-88 MHz.....	0001		PAODDT
7-1-33 (A3)	SS-1600322-502	23386	⌀ Diplexer Assembly 136-174 MHz.....	0001		PAODDT
7-1-33 (A3)	SS-1600322-503	23386	⌀ Diplexer Assembly 403-470 MHz.....	0001		PAODDT
7-1-34 (W5)	SS-3500279-502	23386	⌀ Strap Assy, Ground.....	0001		MDF
7-1-35	MS51957-85	96906	⌀ Screw, Machine (23386/77689) (SPEC CTRL DRW)	0006		PAOZZN
7-1-36	5712-61-63	86928	⌀ Washer, Flat (23386/75171) (SPEC CTRL DRW)	0008		PAOZZN
7-1-37	SS-3400355-1	23386	⌀ Clamp, Front.....	0001		XB
7-1-38	4242-MKX-RAC	23657	⌀ Antenna, 30-88 MHz..... (23386/SS-1600230-1) (SPEC CTRL DRW)	0001		PAOZZN
7-1-39	4265-RAC	23657	⌀ Antenna, 136-174 MHz..... (23386/SS-1600230-2) (SPEC CTRL DRW)	0001		PAOZZN
7-1-40	4266-RAC	23657	⌀ Antenna, 403-470 MHz..... (23386/SS-1600230-3) (SPEC CTRL DRW)	0001		PAOZZN

Figure & Index No.	Part Number	CAGE	Description	Units per Assy	Usable on Code	SMR Code
			1 2 3 4 5 6 7			
7-1-41	SP10SS	1BZ19	⌘ Mast Kit, Tactical Repeater (23386/SS-1600281-1) (SPEC CTRL DRW)	0001		PAOZZN
7-1-41a	SL/33644	1BZ19	\$ \$ Antenna Adapter.....	0001		PAOZZN
7-1-41b	SL33641SH1	1BZ19	\$ \$ Top Guy Rope Assy (Green).....	0003		PAOZZN
7-1-41c	SL33641SH2	1BZ19	\$ \$ Middle Guy Rope Assy (Black).....	0003		PAOZZN
7-1-41d	AR31EF	1BZ19	\$ \$ Mast Section	0002		PAOZZN
7-1-41g	F209	1BZ19	\$ \$ Base Plate.....	0001		PAOZZN
7-1-41h	SL32223	1BZ19	\$ \$ Ground Anchor.....	0003		PAOZZN
7-1-41j	DG33640	1BZ19	\$ \$ Guy Plate	0001		PAOZZN
7-1-41k	Q86	1BZ19	\$ \$ Ground Spike.....	0002		POAZZN
7-1-41l	SL33642-1	1BZ19	\$ \$ Transit Bag.....	0001		PAOZZN
7-1-42	CPRG223/U-30-XX	79557	⌘ Cable, Coaxial, Antenna..... (23386/SS-1600315-1) (SPEC CTRL DRW)	0001		PAOZZN
7-1-43	SS-3100552-501	23386	⌘ Case, Transceiver.....	0002		PAOZZN
7-1-44	275-160-070-000	52473	⌘ Case, Transit, Diplexer..... (23386/SS-1600352-1) (SPEC CTRL DRW)	0001		PAOZZN
7-1-45	SS-3100551-501	23386	⌘ Rod Assy ,Ground	0001		PAOZZN
7-1-46 (W9)	SS-4500107-501	23386	⌘ Cable Assembly, TR 120 V.....	0001		PAOZZN
7-1-47 (W9)	SS-4500108-501	23386	⌘ Cable Assembly, TR 240 V.....	0001		PAOZZN
7-1-48 (W9)	SS-4500109-501	23386	⌘ Cable Assembly, TR 10-32 V	0001		PAOZZN
7-1-49	275-160-100-000	52473	⌘ Case, Transit, Diplexer..... (23386/SS-1600352-2) (SPEC CTRL DRW)	0001		PAOZZN
7-1-50	IC-3300RC	82820	⌘ Cover, Frame	0001		PAOZZN
			(23386/SS-1600254-1) (SPEC CTRL DRW)			

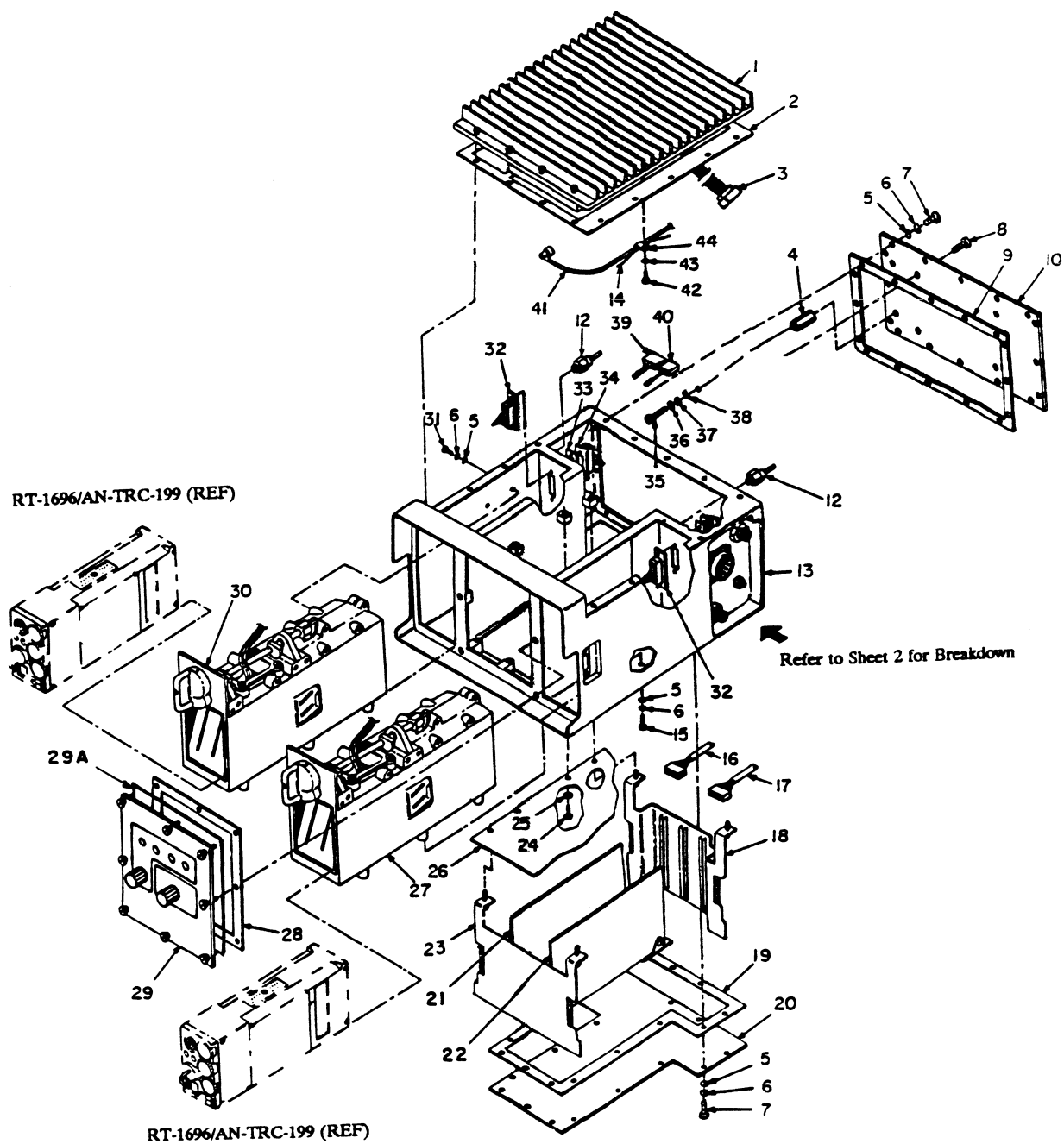


Figure 7-2. Tactical Repeater Assembly (SS-4100806-501)
(Sheet 1 of 2)

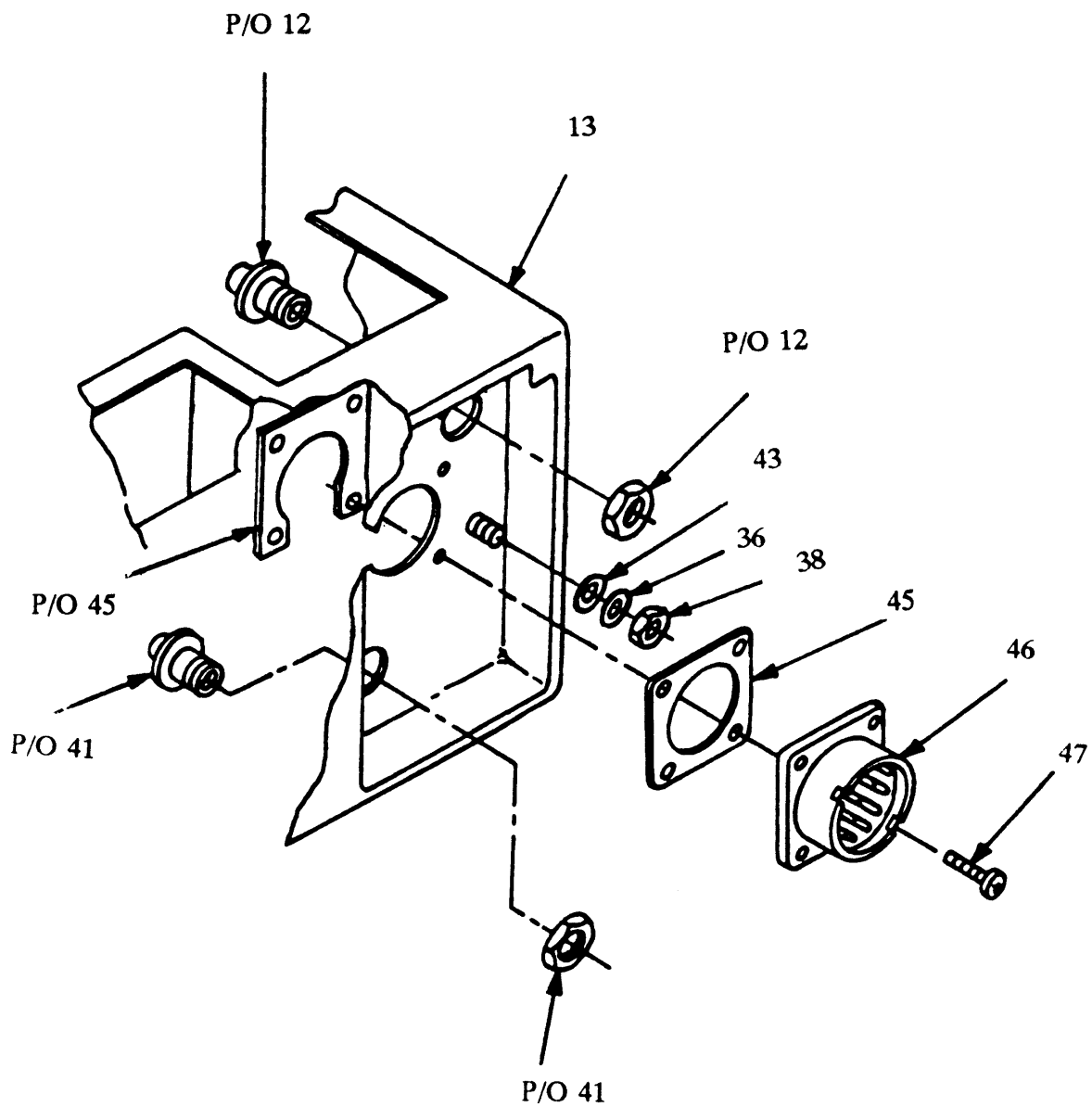


Figure 7-2. Tactical Repeater Assembly (SS-4100806-501)
(Sheet 2 of 2)

Table 7-2. Tactical Repeater Assembly (SS-4100806-501)

Figure & Index No.	Part Number	CAGE	Description 1 2 3 4 5 6 7	Units per Assy	Usable on Code	SMR Code
7-2	SS-4100806-501	23386	Tactical Repeater Assembly (refer to Figure 7-2 for breakdown) (ESD)	0001		PAOLDT
7-2-1 (A6)	SS-4100853-501	23386	⌘ Power Amplifier Assembly (refer to T.O 31R2-2TRC199-3 for breakdown) (ESD)	0001		PAOLDT
7-2-2	SS-4400220-1	23386	⌘ Gasket, EMI	0002		PADZZN
7-2-3 (W1)	SS-3500307-501	23386	⌘ Cable Assembly, PA Power	0001		PADZZN
7-2-4	2111-440-SS-20	27264	⌘ Standoff (23386/SP01-081) (SPEC CTRL DRW)	0002		PADZZN
7-2-5	MS35338-135	96906	⌘ Washer, Lock (23386/75002) (SPEC CTRL DRW)	0020		PADZZN
7-2-6	MS15795-804	96906	⌘ Washer, Flat (23386/75023) (SPEC CTRL DRW)	0020		PAFZZN
7-2-7	MS51957-15	96906	⌘ Screw, Machine (23386/79614) (SPEC CTRL DRW)	0012		PADZZN
7-2-8	MS3212-13	96906	⌘ Screw, Machine (23386/79144-632-06) (SPEC CTRL DRW)	0016		PADZZN
7-2-9	SS-4400226-1	23386	⌘ Gasket, EMI	0001		PADZZN
7-2-10	SS-3400357-1	23386	⌘ Cover, Rear	0001		XB
7-2-11 (A7)	SS-4100732-501	23386	⌘ CCA,+28V DC-DC Converter (ESD)	0001		PADZZN
7-2-12 (W3)	SS-2500091-501	23386	⌘ Cable Assy, Coaxial	0001		PADZZN
7-2-13	SS-4100770-501	23386	⌘ Chassis Assembly, Machined	0001		XB
7-2-14 (W9)	SS-2500122-501	23386	⌘ Cable Assy, AMPL Control	0001		PADZZN
7-2-15	M24308/26-1	81349	⌘ Jackscrew, Electrical (23386/SS-610207) (SPEC CTRL DRW)	0004		PAFZZN
7-2-16 (W7)	SS-3500293-501	23386	⌘ Cable Assy, HHR Control	0001		PADZZN
7-2-17 (W6)	SS-3500293-502	23386	⌘ Cable Assy, HHR Control	0001		PADZZN
7-2-18	SS-3100532-502	23386	⌘ Bracket Assy, Retaining	0001		XB
7-2-19	SS-4400219-1	23386	⌘ Gasket, EMI	0002		PADZZN
7-2-20	SS-4100878-501	23386	⌘ Cover Assy, Bottom	0001		XB

TO 31R2-2TRC-199-1

Figure & Index No.	Part Number	CAGE	Description	Units per Assy	Usable on Code	SMR Code
			1 2 3 4 5 6 7			
7-2-21 (A3)	SS-4100805-501	23386	CCA, Control, Repeater (refer to T.O 31R2-2TRC199-3 for breakdown) (ESD)	0001		PAOLDT
7-2-22 (A1)	SS-4100730-501	23386	CCA, Converter +15V (ESD)	0001		PADZZN
7-2-23	SS-3100531-502	23386	Bracket Assy, Retaining	0001		XB
7-2-24	SFR440X5/16	13074	Screw, Flat Head (23386/SS-79189-440-05) (SPEC CTRL DRW)	0006		PADZZN
7-2-25	MS15795-806	96906	Washer, Flat (23386/75025) (SPEC CTRL DRW)	0004		PADZZN
7-2-26 (A4)	SS-4100811-501	23386	CCA, Parent Board (ESD)	0001		PADZZN
7-2-27 (A8)	SS-4100823-502	23386	Sleeve Assembly, Short	0001		PADZZN
7-2-28	SS-3400331-1	23386	Gasket, EMI	0001		PADZZN
7-2-29 (A5)	SS-4100817-501	23386	Panel Assembly, Control	0001		PAOLDT
7-2-29a	SS-4100867-501	23386	CCA, Panel, Control (ESD)	0001		PADZZN
7-2-30 (A9)	SS-4100823-502	23386	Sleeve Assembly, Short	0001		PADZZN
7-2-31	77616	23386	Screw, Machine (23386/77616) (SPEC CTRL DRW)	0006		PADZZN
7-2-32	82-61461	53217	Plate, Retaining, Electrical (23386/SS-70973) (SPEC CTRL DRW)	0001		PADZZN
7-2-33	82-01871	07700	Shield Gasket (23386/SS-70971) (SPEC CTRL DRW)	0002		XB
7-2-34	MS3212-4	96906	Screw, Machine (23386/SS-79144-440-07) (SPEC CTRL DRW)	0004		PADZZN
7-2-35	MS51957-14	96906	Screw, Machine (23386/77614) (SPEC CTRL DRW)	0004		PADZZN
7-2-36	MS35338-139	96906	Washer, Lock (23386/75006) (SPEC CTRL DRW)	0001		PADZZN
7-2-37	MS15795-810	96906	Washer, Flat (23386/75029) (SPEC CTRL DRW)	0001		PADZZN
7-2-38	71206	73734	Nut, Wing (23386/SS-754007) (SPEC CTRL DRW)	0001		PADZZN
7-2-39 (W4)	SS-2500120-501	23386	Cable Assy, Coaxial	0001		PADZZN
7-2-40 (W5)	SS-2500124-501	23386	Cable Assy, PA Power	0001		PADZZN
7-2-41 (W2)	416-1613-001	74790	Cable, Coaxial, Shield (23386/SS-3600079-1) (SPEC CTRL DRW)	0001		PADZZN
7-2-42	M24308/25-9	81349	Screw-Lock Assembly (23386/610033) (SPEC CTRL DRW)	0004		PAFZZN

Figure & Index No.	Part Number	CAGE	Description							Units per Assy	Usable on Code	SMR Code
			1	2	3	4	5	6	7			
7-2-43	5710-54-25	86928	⌘	Washer, Flat						0001		PADZZN
				(23386/75106) (SPEC CTRL DRW)								
7-2-44	F4NY-250BK	85480	⌘	Cable, Clamp						0002		PADZZN
				(23386/81252) (SPEC CTRL DRW)								
7-2-45	Z-2212	76385	⌘	Grommet						0001		PADZZN
				(23386/SS-81226) (SPEC CTRL DRW)								
7-2-46	FSU-2201	04967	⌘	Connector, Receptacle						0002		PADZZN
				(23386/SS-64022) (SPEC CTRL DRW)								
7-2-47	MS51957-28	96906	⌘	Screw, Machine						0004		PADZZN
				(23386/77628) (SPEC CTRL DRW)								

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Figure 7-3. Power Amp Assembly, 15W (SS-4100853-501)

Table 7-3. Power AMP Assembly, 15W (SS-4100853-501)

Figure & Index No.	Part Number	CAGE	Description 1 2 3 4 5 6 7	Units per Assy	Usable on Code	SMR Code
7-3	SS-4100853-501	23386	Power Amplifier Assy, 15W (ESD).....	0001		PAOLDT
7-3-1	SS-4100855-501	23386	⌘ Amplifier Assy,15W..... (refer to T.O. 31R2-4-1085-5 for breakdown) (ESD)			
7-3-2	MS3212-15	96906	⌘ Screw, Machine..... (23386/79144-632-08) (SPEC CTRL DRW)	0006		PADZZN
7-3-3	SS-4100836-501	23386	⌘ Cover, Heatsink, VA.....	0001		XB

Section III. NUMERICAL INDEX

Part Number	Figure & Item Number	Part Number	Figure & Item Number	Part Number	Figure & Item Number
2111-440-SS-20	7-2-4	9268-A257-16	7-1-28	MS21919WDG4	7-1-29
275-160-100-000	7-1-49	9286-A194-16AB	7-1-18	MS21919WDG7	7-1-26
275-160-070-000	7-1-44	CPRG223/U-30-XX	7-1-42	MS3212-4	7-2-34
416-1613-001	7-2-41	F4NY-250BK	7-2-44	MS3212-13	7-2-8
4242-MKX-RAC	7-1-38	FSU-2201	7-2-46	MS3212-15	7-3-2
4265-RAC	7-1-39	IC-3300RC	7-1-50	MS35338-139	7-1-8
4266-RAC	7-1-40	M24308/25-9	7-2-42	MS35338-138	7-1-16
5710-54-25	7-2-43	M24308/26-1	7-2-15	MS35338-139	7-2-36
5712-61-63	7-1-36	MS15795-842	7-1-17	MS35338-135	7-2-5
71206	7-1-14	MS15795-804	7-2-6	MS35650-104	7-1-15
71206	7-2-38	MS15795-810	7-1-9	MS35690-410	7-1-13
77616	7-2-31	MS15795-810	7-2-37	MS51957-14	7-2-35
82-61461	7-2-32	MS15795-806	7-2-25	MS51957-15	7-2-7
82-01871	7-2-33	MS21318-20	7-1-4	MS51957-28	7-2-47
MS51957-79	7-1-7	SS-3100532-502	7-2-18	SS-4100867-501	7-2-29a
MS51957-84	7-1-10	SS-3100546-501	7-1-6	SS-4100878-501	7-2-20
MS51957-85	7-1-35	SS-3100552-501	7-1-43	SS-4400219-1	7-2-19
MS51957-87	7-1-22	SS-3400331-1	7-2-28	SS-4400220-1	7-2-2
MS51958-73	7-1-20	SS-3400353-1	7-1-19	SS-4400225-1	7-1-5
MS51958-61	7-1-25	SS-4100806-501	7-1-1	SS-4400226-1	7-2-9
SFR440X5/16	7-2-24	SS-4100807-512	7-1-2	SS-4500107-501	7-1-46
SP10SS	7-1-41	SS-4100811-501	7-2-26	SS-4500108-501	7-1-47
SS-1600322-501	7-1-33	SS-4100817-501	7-2-29	SS-4500109-501	7-1-48
SS-1600322-502	7-1-33	SS-4100823-502	7-2-30	SS-4500110-501	7-1-32

Part Number	Figure & Item Number	Part Number	Figure & Item Number	Part Number	Figure & Item Number
SS-1600322-503	7-1-33	SS-4100823-502	7-2-27	Z-2212	7-2-45
SS-2400523-1	7-1-3	SS-4100836-501	7-3-3		
SS-2400577-1	7-1-27	SS-4100853-501	7-2-1		
SS-2400578-1	7-1-24	SS-4100853-501	7-3		
SS-2500091-501	7-2-12	SS-4100855-501	7-3-1		
SS-3100531-502	7-2-23	SS-4100859-501	7-1-20		

Section IV. REFERENCE DESIGNATION INDEX

Reference Designator	Figure & Item Number	Reference Designator	Figure & Item Number	Reference Designator	Figure & Item Number
Radio Set AN/TRC-199	7-1-REF	W3	7-2-12		
A1	7-1-1	W4	7-2-39		
A3	7-1-33	W5	7-2-40		
A3	7-1-33	W6	7-2-17		
A3	7-1-33	W7	7-2-16		
A4,A5	7-1-2	W9	7-2-14		
W1	7-1-32				
W2	7-1-30				
W3	7-1-23				
W4	7-1-31				
W5	7-1-34				
W6	7-1-12				
W7	7-1-11				
W9	7-1-48				
W9	7-1-46				
W9	7-1-47				
Tactical Repeater Assembly (SS- 4100806-501)	7-2-REF				
A1	7-2-22				
A3	7-2-21				
A4	7-2-26				
A5	7-2-29				
A6	7-2-1				
A7	7-2-11				
A8	7-2-27				
A9	7-2-30				
W1	7-2-3				
W2	7-2-41				

Section V. COMMON BULK ITEMS LIST

Part Number	CAGE Code	Description	Unit of Measure
No 222 50CC	05972	Threadlocking Compound No. 222 (23386/91172)	A/R

CHAPTER 8.0

CIRCUIT DIAGRAMS

8-1 SCOPE.

This chapter contains the following diagram:

<u>Figure No.</u>	<u>Title</u>
FO-1	Radio Set AN/TRC-199, Interconnection Diagram

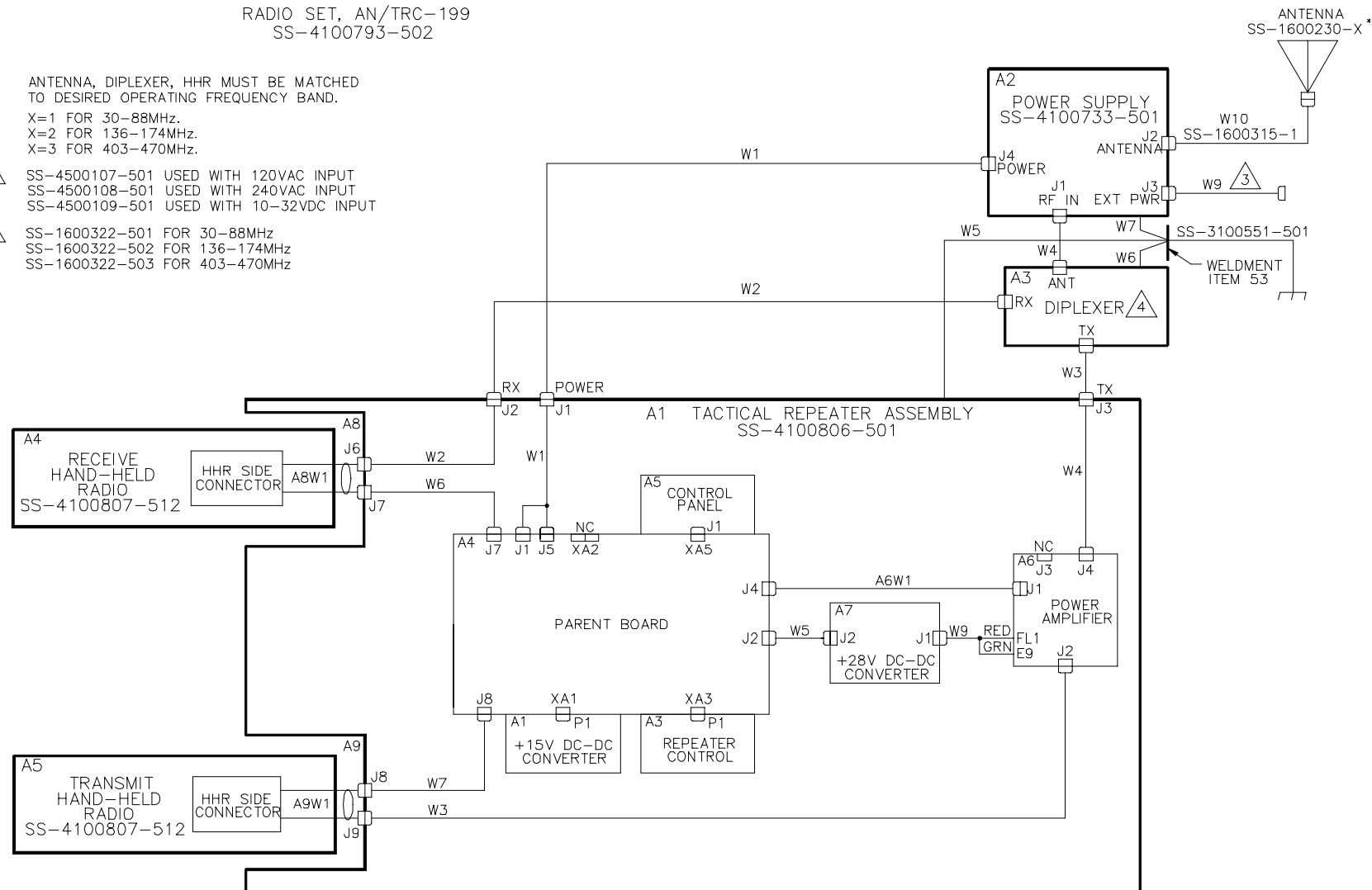
RADIO SET, AN/TRC-199
SS-4100793-502

ANTENNA, DIPLEXER, HHR MUST BE MATCHED
TO DESIRED OPERATING FREQUENCY BAND.

- *
X=1 FOR 30-88MHz.
X=2 FOR 136-174MHz.
X=3 FOR 403-470MHz.

3. SS-4500107-501 USED WITH 120VAC INPUT
SS-4500108-501 USED WITH 240VAC INPUT
SS-4500109-501 USED WITH 10-32VDC INPUT

4. SS-1600322-501 FOR 30-88MHz
SS-1600322-502 FOR 136-174MHz
SS-1600322-503 FOR 403-470MHz



FO-1. Radio Set AN/TRC-199,
Interconnection Diagram

GLOSSARY

AC	Alternating current
ALC	Automatic level control
ANT	Antenna
ASSY	Assembly
C	Celsius (centigrade)
CCA	Circuit card assembly
CCI	Controlled cryptographic item
CLR	Clear
CM	Centimeter
CTCSS	Continuous tone-controlled squelch system
CTRL	Control
CW	Continuous wave
dB	Decibels
dBi	Decibel (isotropic)
dBd	Decibels relative to a 1/2 wavelength dipole
dBm	Power in decibels (referenced to 1 milliwatt)
DC	Direct current
DRW	Drawing
ESD	Electrostatic discharge
ESDS	Electrostatic discharge sensitive
EXT	External
F	Fahrenheit
FM	Frequency modulation (modulated)
GND	Ground
HF	High frequency
HZ	Hertz
IF	Intermediate frequency
in.	Inch
INT	Internal
kbps	Kilobits/second
kg	Kilogram
kHz	Kilohertz
Lbs	Pounds
LED	Light emitting diode
MHz	Megahertz
NiCad	Nickle Cadmium
PTT	Push-to-talk
RCV	Receive
RX	Receiver
SINAD	Signal + noise distortion/noise + distortion
SPEC	Specification
SMR	Source, Maintenance and Recoverability
TUNERX	Tune receiver
TUNETX	Tune transmitter
TX	Transmitter
UHF	Ultra high frequency
V	Volt
VAC	Volts alternating current
VHF	Very high frequency
W	Watt

ALPHABETICAL INDEX

<u>Subject</u>	<u>Paragraph, Figure or Table Number</u>
A	
Antenna Assembly:	
Description	P1-1.2.3
Removal and Replacement Procedures	P6-5.1.2
C	
Cables, Interconnecting	T2-2
Capabilities and Limitations	P1-3, T1-3
Control Panel Assembly (A5):	
Functional System Operation	P5-2.4
Removal/Replacement Procedures	P6-5.2.2
Controls and Indicators:	P4-2
Diplexer Controls	T4-4, F4-4
Indicators, Controls, and Switches	T4-1, F4-1
Power Switches	T4-2, F4-2
Connectors	T4-3, F4-3
D	
DC-DC Converter CCA (A7):	
Functional System Operation	P5-2.6
Description, Equipment:	
Antenna Assembly	P1-1.2.3
Diplexer	P1-1.2.4, F1-3
Power Supply Assembly	P1-1.2.5
Receiver-Transmitters	P1-1.2.2, F1-2
Tactical Repeater Assembly	P1-1.2.1, F7-1
Diplexer:	
Controls	T4-4, F4-4
Description	P1-1.2.4, F1-3
Removal and Replacement Procedures	P6-5.1.6
E	
Equipment	
Description	P1-1.2
Function and Purpose	P1-1.1
Equipment Required but not Supplied	P1-5, T1-5
Equipment Supplied	P1-4, T1-4

<u>Subject</u>	<u>Paragraph, Figure or Table Number</u>
	F
Functional Operation of Electronic Circuits	
Repeater Control CCA (A3)	P5-3, F5-2
15 Watt Power Amplifier Assembly (A6)	P5-4, F5-3
Functional System(s) Operation	P5-2
AC/DC Power Supply (A2)	P5-2.10
Antenna System	P5-2.8
Control Panel (A5)	P5-2.4
Diplexer	P5-2.9
Parent Board CCA (A4)	P5-2.3
Receiver-Transmitter	P5-2.7
Repeater Control CCA (A3)	P5-2.2
RF Power Amplifier Assembly (A6)	P5-2.5
+15V DC-DC Converter CCA (A1)	P5-2.1
+28V DC-DC Converter CCA (A7)	P5-2.6
	H
Handling and Storage	P3-6
Handling, Material	P2-6
	I
Installation:	
Buildings and Other Support Structures	P2-8
Cables	P2-7, T2-2
Housing	P2-4
Interconnection Diagram	FO-1
Installation Sequence:	P2-10
Antenna/Mast Installation	P2-10.1
Diplexer Installation	P2-10.5
External Power Supply	P2-10.4
Ground Rod Installation	P2-10.3
Lithium Battery Installation	P2-10.2
Receiver-Transmitter Transceiver Module Installation	P2-10.6
Material Handling	P2-6
Packing	P3-5, F2-1
Receiving Data	P2-5, T2-1
Site Preparation	P2-2
Special Tools and Test Equipment Required	P2-9
Unpacking and Inspections	P2-3
Interconnection Diagram	FO-1
	L
Leading Particulars	P1-2, T1-2

<u>Subject</u>	<u>Paragraph, Figure or Table Number</u>
O	
Operating Procedures:	
Covert Operations	P4-6
Equipment Shutdown	P4-8
Initial Power-Up and Diplexer Tuning	P4-3
Receiver-Transmitters	P4-7
Receiving Message	P4-4
Transmitting Message	P4-5
Operational Checkout:	
Display Off Control	P6.2.2
Fault LED	P6-2.5
Power-Up Verification	P6-2.1
Receive Tune Mode Verification	P6-2.3
Transmit Tune Mode Verification	P6-2.4
P	
Packing	P3-5
Packaging Diagram	F2-1
Parent Board CCA (A4):	
Functional System Operation	P5-2.3
Power Amplifier Assembly (A6):	
Functional Operation of Electronic Circuits	P5-4
Functional System Operation	P5-2.5
Removal/Replacement Procedures	P6-5.2.3
Power Supply Assembly:	
Description	P1-1.2.5
Removal and Replacement Procedures	P1-1.2.5
Preparation for Reshipment	P3-4
Preparation for use:	
Inspection	P3-2
Post-Installation Checkout	P3-3
R	
Receiver-Transmitter:	
Description	P1-1.2.2, F1-2
Removal and Replacement Procedures	P6-5.1.3
Related Technical Manuals	P1-7, T1-6
Removal/Replacement Procedures	
Antenna	P6-5.1.2
Antenna Cable	P6-5.1.1
Control Panel Assembly (A5)	P6-5.2.2
Diplexer	P6-5.1.6
Power Cable	P6-5.1.4
Power Supply	P6-5.1.5
Receiver-Transmitter	P6-5.1.3
Repeater Control CCA (A3)	P6-5.2.1
Tactical Repeater Assembly	P6-5.1.7
15 Watt Power Amplifier Assembly (A6)	P6-5.2.3

<u>Subject</u>	<u>Paragraph, Figure or Table Number</u>
	R
Repeater Control CCA (A3):	
Functional Operation of Electronic Circuits	P5-3
Functional System Operation	P5-2.2
Removal/Replacement Procedures	P6-5.1.3
	S
Servicing:	P6-3
Inspection	P6-3.2
Preventive Maintenance	P6-3.3
Servicing Intervals	P6-3.1, T6-4
Site Preparation	P2-2
Support Equipment	P1-6, T1-4
	T
Tactical Repeater Assembly:	
Description	P1-1.2.1, F7-2
Indicators, Controls, and Switches	T4-1, F4-1
Removal and Replacement Procedures	P6-5.6.7
Technical Manuals, Related	P1-7, T1-6
Tools, Special and Test Equipment	P1-6
Troubleshooting	P6-4
Organizational Maintenance Guide - Operator	T6-5
Organizational Maintenance Guide - Repair Specialist	T6-6
	U
Unpacking and Inspections	P2-3